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MYCOLOGIA

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DIAGNOSES OF AMERICAN PORIAS—I*

L. O. OVERHOLTS

(WITH PLATE 1 AND FIGURES 1–6 IN THE TEXT)

PORIA AMBIGUA Bres., Atti Accad. Rovereto III 3: 84. 1897

Original Description: Latissime effusa, margine superiore reflexo, alba, demum stramineo-isabellina, subiculo membranaceo, arcte adnata, albo, tubuli ut plurimum obliqui, hic inde noduloso-congesti, usque ad 8 mm. longi; pori majusculi, angulati, demum dentato-laceri; sporae hyalinae, obovatae, 5–8 x 3.5 μ; basidia clavata, 18–20 x 6–8 μ; cystidia fusoidea, apice muricelata et demum laeva, 24–30 x 6–8 μ; hyphae subhymeniales tenuiter tunicatae, septatae, 3–4 μ latae.

Ad truncos *Fagi, Carpini, . . . Piri communis . . . Robiniae pseudacaciae.*

Nutat inter *Poria* et *Irpices.*

Redescription: Annual, effused in orbicular or elongated patches 3–10 cm. long and 2–5 cm. broad, inseparable, where best developed with a regular, white, sterile, shortly pubescent margin 2–2.5 mm. broad; subiculum thin, white, inconspicuous; tubes unstratified, 0.5–6 (usually 2–4) mm. long, pure white to dirty white when fresh, often cinnamon-buff to cinnamon in dried plants, angular, very thin-walled, often with the shape of an inverted cone, the dissepiments finely ciliate-dentate, averaging 1–3 per mm.; spores ellipsoidal or oblong-ellipsoidal, smooth, hyaline, 4–6 x 2.5–3.5 μ; cystidia absent or very inconspicuous; tramal tissue compact, of long and flexuous, simple or somewhat branched hyphae, with occasional or rare cross walls, no clamps, diameter 3–4.5 μ; subiculum hyphae more branched, with more numerous cross walls, no clamps, diameter up to 6 μ.

* Contribution from the Department of Botany, The Pennsylvania State College, No. 35.

[MYCOLOGIA for November (13: 279–365) was issued January 21, 1922.]

On bark or wood of *Alnus, Amelanchier, Fagus, Gleditsia, Quercus,* and probably other deciduous trees; rarely on the ground or at the base of stumps, and then often encircling grass, weed stems, etc., in its growth.

Specimens Examined: Syracuse, N. Y.; Dayton and Oxford, Ohio (two collections); New Richmond and Ann Arbor, Mich.; St. Croix River, Minn.; St. Louis, Mo.; Fayetteville, Ark.

The writer's acquaintance with this species dates back to 1910, when it was collected at Oxford, Ohio, by Miss Audrey Richards and turned over to him for examination. Another collection was made in 1911, and in 1912 it was found growing on the ground

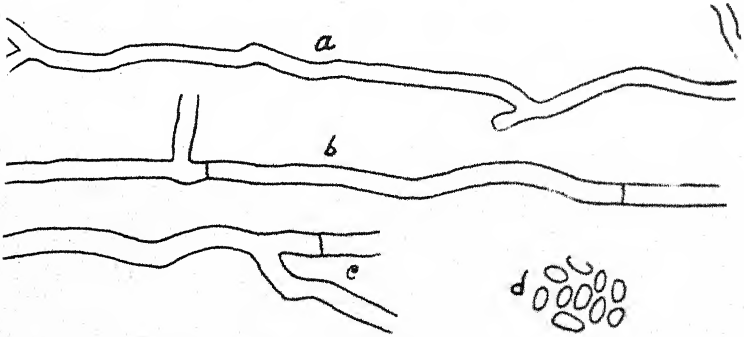


FIG. 1. *P. ambigua.* *a*, Hypha from the trama; *b*, Hypha from the subiculum; *c*, Larger type of hypha usually present; *d*, Spores.

in the garden of Professor Bruce Fink at Oxford. This latter collection was sent to Bresadola, who referred it to *P. ambigua*, described by him from Europe in 1897.

When fresh and growing, the color is white or dirty white, and the consistency of the fungus is soft but not watery. Older specimens, especially on drying, are apt to become darker, approaching cinnamon in color, but the affinities of the species are with the white Porias.

The tubes vary considerably in size, and there are always a considerable number that are inversely conical or funnel-shaped, perhaps due to the coalescence of two or more of them, as these are always larger than those that retain their cylindrical shape. The

peculiar shape of these tubes with their finely ciliate-dentate walls is a distinct aid in recognizing the plants in the field.

Internally the structure of the plant recalls that of *Polyporus pargamenus* Fr., although striking microscopic differences are not

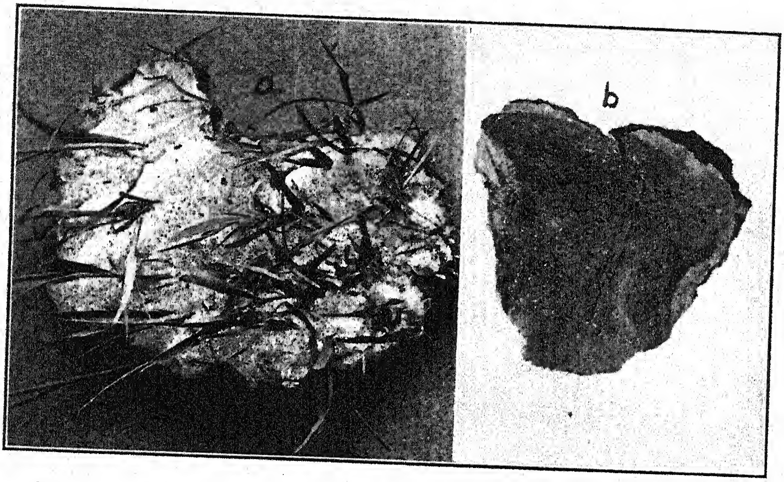


FIG. 2. *P. ambigua.* *a,* Specimen collected and photographed by Dr. A. H. W. Povah, Syracuse, N. Y., showing how the plant may grow around grasses, twigs, etc. (Overholts Herb. No. 5351.) *b,* Resupinate specimen on bark of *Fagus.* (Overholts Herb. No. 247.) × 1.

lacking. Plants in all stages of maturity show an abundance of oblong-ellipsoidal spores that measure 4–6 x 2.5–3.5 μ (Fig. 1, *d*). Their abundance suggests the possibility of their being conidial, but in sections of the hymenium it is not difficult to trace their connection to normal four-sterigmate basidia. Even a crushed preparation of the hymenium yields an abundance of spores. There are usually no cystidia to be seen, but prolonged search will sometimes yield inconspicuous conical or crystalline-capitate bodies, scarcely projecting beyond the basidia (Pl. I, fig. 6, *a*), and at first sight not readily distinguished from the latter. They are about 6 μ in diameter. The hyphae form a distinctive character of the species (Fig. 1, *a–c*). They are long and flexuous, with cross walls but no clamp connections, and are considerably branched. Those of the subiculum are more branched than those in the trama, have more frequent cross walls, and reach larger

diameters. In the trama it is not uncommon to find them without cross walls and only infrequently branched. The diameter of those of the trama varies from 3–4.5 μ, while in the subiculum they are mostly 4–6 μ.

Resupinate specimens of *Polyporus tulipiferus* and *P. pargamenus* have considerable resemblance to these plants. This is especially true of the former species in which the spores, especially before reaching mature size, are quite similar to those of this species. But in *P. tulipiferus* they are never obtainable in abundance in crushed mounts of the hymenium as they are in *P. ambigua*. Moreover, that species has conspicuous incrusted cystidia not difficult to find, and the diameter of the subiculum hyphae is not as great as in *P. ambigua*. Neither are the peculiar inversely conical tubes found in the former plant. From *P. pargamenus* the spores serve as the best distinguishing character, for in that species they are allantoid, 3–4 x 1 μ. The hyphae there are long and straight in both trama and subiculum, with few or no cross walls, unbranched, and the hymenium soon becomes decidedly irpiciform. These conditions are quite at variance with those found in *P. ambigua*.

The distinctive characteristics of the plant may be said to be the soft white growth, the inverted conical shape of some of the tubes, the abundant spores, lack of conspicuous cystidia, and the branched hyphae with cross walls but no clamps.

American collections of this species have been compared with authentic material kindly furnished by Rev. Bresadola, the author of the species, and they agree in all essential respects. The spore measurements given by the author are slightly larger than I find in both American and European material, but the difference is negligible. Rev. Bresadola also states that cystidia are present in the European plant, and on examining his material I find the same condition of affairs as described above for American material. In fact, the agreement of American and European material is in all particulars much closer than is ordinarily the case between species so widely separated.

Poria ferruginosa (Schrad.) Fr., Syst. Myc. 1: 378. 1821

Description, Fries, l. c.: Effusus, crassus, ferrugineo-spadiceus, poris subrotundis inaequalibus.

Inaequalis, saepe interruptus, durus, ½–1 unc. crassus, omnino excarnis. Pori mediae magnitudinis, subobliqui, acute.

Ad truncos Alneos. Aest.

Redescription: Effused for several centimeters on decorticated wood or rarely on bark; annual or at times perennial, 0.5–5 mm. thick, mostly inseparable, when young and growing with a brown tawny pubescent margin less than 1 mm. broad, when mature losing this and becoming entirely fertile; subiculum very thin, usually not more than 0.5 mm. thick, fibrous, scarcely discernible in thin fructifications; tubes frequently oblique, in one or rarely as many as four layers, 1–2 mm. long each season, not distinctly stratified in perennial specimens, brown within or the older layers somewhat whitish pubescent under a lens; the mouths cinnamon, sayal brown, or snuff brown, usually entirely without sheen though in some specimens a slight silkiness may be detected, unchanging on drying and the colors constant in herbarium specimens, subcircular to subangular, the dissepiments at most of only medium thickness and becoming thinner at maturity, even and entire except where growing in oblique situations, averaging 4–6 per mm.; spores oblong-ellipsoidal or oblong, hyaline, $4.5–5 \times 2–3\,\mu$; setae more or less abundant, rather short and sharp pointed, typically projecting 15–30 μ beyond the basidia, 5–7 μ diameter; hyphae straight and rigid, brown, no cross walls except rarely in the young hyphae, no clamps, simple, 2–3 μ diameter.

On dead wood of *Acer, Alnus, Fagus, Prunus, Populus, Salix, Ulmus, Quercus, Betula, Ostrya,* and perhaps other deciduous trees.

Specimens Examined: North Conway and Crawford Notch, N. H.; Cold Spring Harbor, Cranberry Lake, Vaughns, Karner, Crown Point, and Mechanicsville, N. Y.; Greenwood Furnace, Pa.; Oxford and Cincinnati, Ohio; Ann Arbor and New Richmond, Mich.; Edgemont, Ill.; Evaro, Mont.; Bellingham, Wash.; Ontario, Canada.

Apparently the species may be expected on all kinds of deciduous woods, but none have yet been seen on a coniferous substratum. It appears to be a species more abundant in the north and no specimens have been examined from south of Ohio. Ordinarily

the plant does not separate readily from the substratum and old specimens are entirely inseparable. But collections have been noted in which the young growing specimens on a smooth surface peel off in strips.

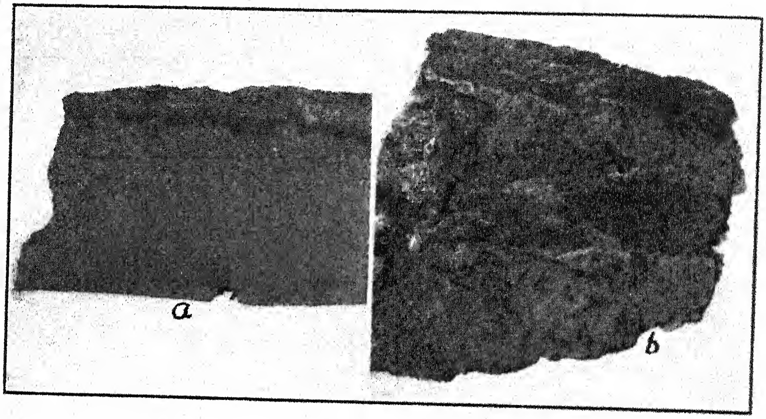


FIG. 3. *P. ferruginosa.* *a*, Specimen from Washington, on *Acer* (3879); *b*, Specimen from New Hampshire, on *Fagus* (5006). × 1.

When growing on an uneven surface or in a very oblique position the hymenium may be quite uneven and nodulose or thrown into distinct undulations. An extreme case of this unevenness is seen in specimens collected in Canada by Macoun and made the basis of a new species, *P. macouni*, by Peck. In these the plants were growing over old mosses. Otherwise they are typical *P. ferruginosa*.

Usually the species is annual or at least most of the collections examined are of the annual type. The greatest departure from this condition that has come under observation is in specimens on *Acer* from Washington, collected by Weir. In these, four layers of tubes are present. When cut with a sharp knife and examined under a lens these layers of tubes are fairly distinct, but to the naked eye they are not sharply separated. The hymenial surface of old weathered specimens occasionally fades out to gray.

The affinities of the species are with *P. viticola* Schw., for which a better name is probably *P. (Trametes) tenuis* Karst. From this species it is distinct in the spores, which there are cylindric

and measure 6–7 x 2 μ, consequently longer and more slender in proportion than in *P. ferruginosa*. In most cases there is an additional difference in the setae, which here project only 15–20 μ (Pl. I, figs. 3–4), or at most not more than 27 μ, beyond the basidia, while in *P. viticola* they are usually much longer, sometimes projecting as much as 60 μ beyond the basidia. However, a few collections of *P. viticola* have been noted in which this distinction does not hold, but in which the setae are quite like those of *P. ferruginosa*. In such cases the importance of the spores as a distinguishing character is much enhanced. Of course, some collections

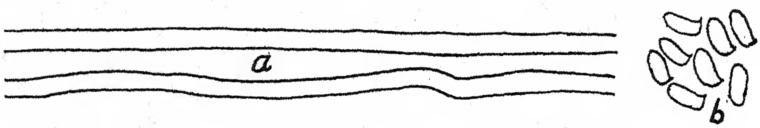


FIG. 4. *a*, Hyphae of *P. ferruginosa*; *b*, Spores.

do not contain spores, and other characters must be used in distinguishing between this species and its allies. However, the difference between the setae in ordinary cases is striking, especially if they be compared side by side under the microscope. Occasionally the hymenium of *P. viticola* is somewhat daedaloid—a condition never seen in *P. ferruginosa*.

Poria marginella Peck is a similar species on coniferous wood, but its spore characters are those of *P. viticola*.

The decay caused by this fungus is of the general delignifying type, producing a uniform whitening and softening of the sapwood. No striking characteristics are shown by it. The fungus is apparently not an organism inducing rapid decay, and as it is almost entirely confined to the smaller branches is not of great economic importance in producing timber loss.

PORIA NIGRESCENS Bres., Atti Accad. Rovereto III 3: 83. 1897

Original Description: Late effusa—subiculo membranaceo, stramineo, facile separabili, 1–1.5 mm. crasso; tubulis concoloribus, usque ad 2 mm. longis; poris parvis, subrotundis, in vegeto albis, dein pallide carneo-violaceis, demum nigrescentibus; hyphis subhymenialibus tenuiter tunicatis, 4–6 μ latis; sporis non visis.

Perennans, stratosus, tubulis singolorum annorum strato intermedio floccoso distinctis.

Ad truncos emortuos *Abietis pectinatae.* Hung.

Redescription: Perennial, or at least often persisting for as much as three or four years, effused in orbicular or elongated patches 3–9 cm. long, 2–5 cm. broad, and up to 1.5 cm. thick, separable at least in age, with a narrow adnate or loosening border on which partially formed pores are visible under a lens; subiculum distinct but scarcely 0.5 mm. thick, white when fresh, more yellowish on drying; tubes in old plants in distinct layers separated by thin layers of context and in drying sometimes partially loosening from each other, typically with the growth of each season not covering all the hymenial area produced in the preceding season, 1.5–5 mm. long each season, close to light vinaceous fawn (flesh color) when fresh, some specimens drying out to cinnamon drab or avellaneous, others to fuscous or dusky drab, subcircular to angular, rather thick-walled, averaging 5–6 per mm., the dissepiments entire; spores broadly ellipsoidal to nearly globose, smooth, hyaline, 3–5 μ diameter; cystidia none; hyphae hyaline, mostly very thick-walled, simple, with cross walls but no clamps, diameter 4.5–7.5 μ.

On rotten logs of deciduous wood, especially beech and birch.

Specimens Examined: North Conway, N. H.; Ithaca, Jamesville, and Catskill Mts., N. Y.; Oxford and West Elkton, Ohio; Frankfort, Mich.

The characteristic features of the species appear to be the flesh-colored tint of the hymenium of fresh plants, this fading and darkening on drying; the peculiar perennial habit with the receding growth and well-marked layers of successive years; and the very compact trama with thick-walled hyphae as much as 7.5 μ diameter (Fig. 6, *a*).

No specimens are at hand in which more than four layers of tubes are present, and the plant is evidently not indefinitely perennial. Each layer of tubes is laid down on a thin, distinct layer of context, and in dried specimens these layers have separated to such an extent that they may be readily removed, one from the other. Moreover, the peculiar habit of the receding marginal growth suggests that at the beginning of successive years the hyphae that have persisted are in localized areas from which the current season's growth proceeds, forming at first, on the surface of the old hymenium, small orbicular patches which gradually enlarge but never or rarely cover the entire area of the old hymenium.

In cross sections of the hymenium the trama is seen to be very compact, the sections of the closely crowded, thick-walled hyphae giving a pseudo-cellular appearance (Pl. I, fig. 2), such as is always found in similar sections of the hymenium of *Fomes connatus,* a common perennial sessile form on species of *Acer.* Moreover, Bresadola, the author of this species, states that it has often been confused with the resupinate form of *F. connatus* (=*F.*

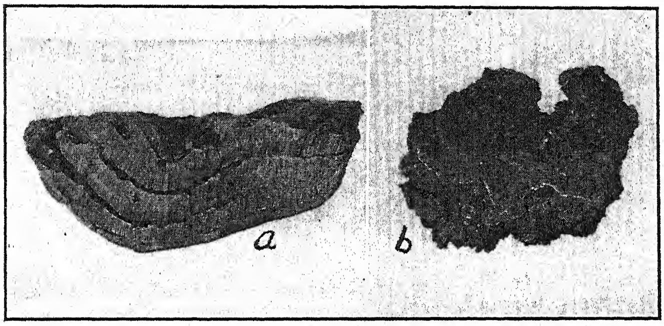


FIG. 5. *P. nigrescens.* *a,* Lateral view of vertical section through sporophore, showing the evident, separating annual layers; *b,* Surface view showing the failure of growth of current season to cover the entire growth of the previous year. × 1.

populinus). This pseudo-parenchymatous appearance is also present in the hymenium of *Polyporus rigidus* Lév. as interpreted by the writer, which species is also often entirely resupinate, has a flesh-colored hymenium when fresh, the spores being similar. However, that species does not become noticeably darker on drying, nor is it ever perennial. In the present species the hymenium in some collections is now quite blackish or smoke-colored.

The identity of American collections rests in part on the opinion of Rev. Bresadola, its author, who so referred specimens of one of the collections cited above. In addition he has very kindly communicated to the writer a small portion of co-type material which has been carefully examined and with which the writer's specimens agree quite fully. The original description says "sporis non visis," and, curiously enough, they are rarely found in dried American specimens, but have been found abundantly in fresh material. In the co-type material they are absent from the appar-

ently well-developed and matured part of the hymenium, as are also the basidia, but on examining the forming tubes on the marginal growth a number of spore-like bodies, the counterparts of the spores found in fresh American collections, were encountered. They were not attached to basidia, but in all probability represent

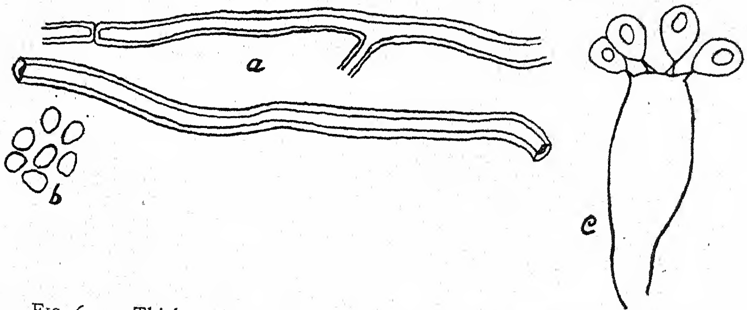


FIG. 6. *a*, Thick-walled hyphae characteristic of *P. nigrescens*; *b*, Spores; *c*, Basidium with 4 spores.

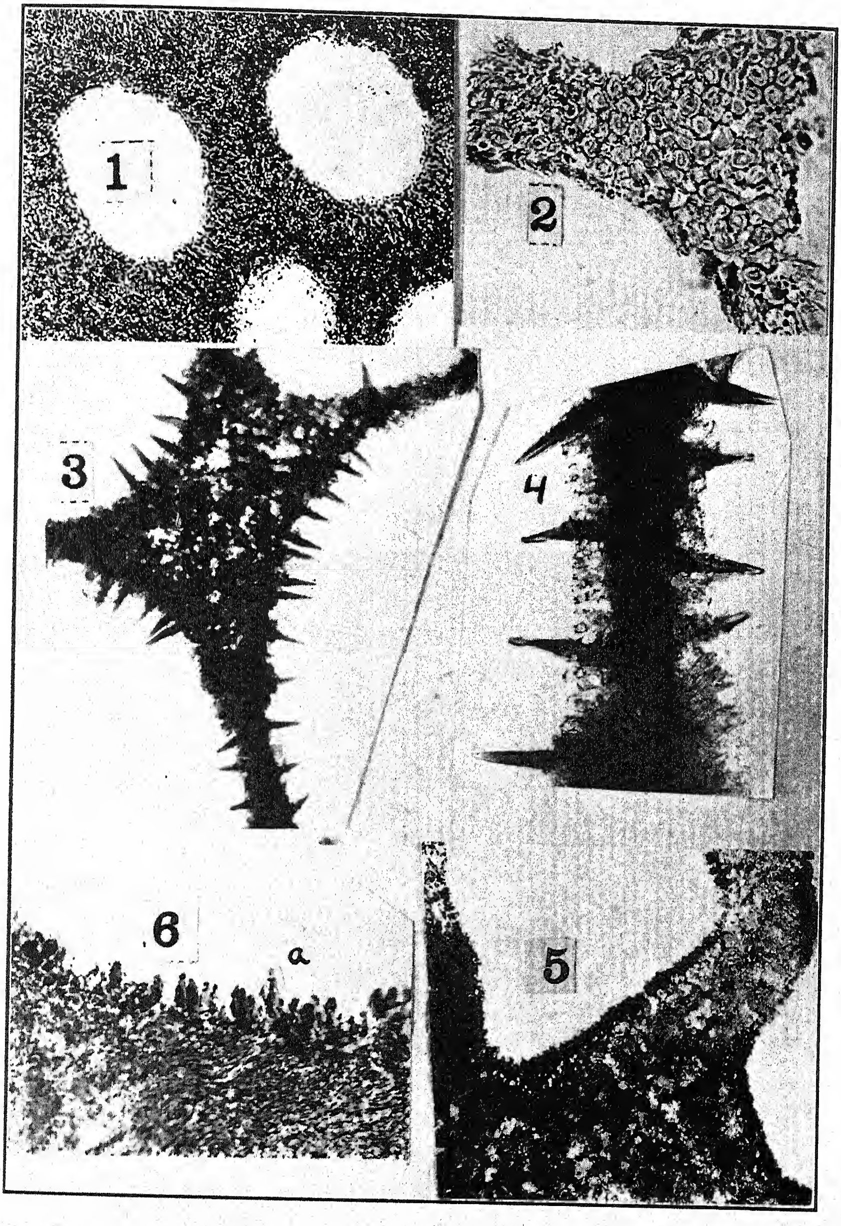
the spores of the specimen. In practically all cases basidia and spores are uniformly absent from the tubes of well-developed specimens (Pl. I, figs. 1–2).

Bresadola's specimens were said to have grown on the wood of *Abies pectinata*, a coniferous substratum, while all American collections so far examined have been from the wood of deciduous trees.

Dr. Murrill[1] considers this plant not specifically distinct from *P. undata* (Pers.) Bres., and gives, among others, *P. odora* Peck and *Polyporus broomei* Rab. as synonyms. *P. odora* was recently described[2] by myself as having allantoid spores which would remove the possibility of its being connected with the present species. Since the publication of Dr. Murrill's opinion I have reexamined specimens from Peck's types and have thoroughly convinced myself that my former statement was correct. I have found abundant allantoid spores attached to 4-sterigmate basidia. As previously stated, the older parts of the hymenium in this collection are not in sporulating condition, but toward the margin of

[1] Mycologia 13: 87. 1921.

[2] Bul. N. Y. State Mus. 205–206: 97–99. 1919.



1, 2. PORIA NIGRESCENS
3, 4. PORIA FERRUGINOSA
5, 6. PORIA AMBIGUA

the fructification I find the spores as described. My sectional preparations have been exhibited to other members of the Botany Department at this institution and all have agreed that no other interpretation is possible. On the other hand, I have repeatedly demonstrated the connection of the globose spores of *P. nigrescens* with their basidia (Fig. 6, *c*). Consequently these plants can not represent the same species, although so similar that at present the writer is not aware of any separating characters other than the spores and the basidia. The basidia of *P. nigrescens* are large, 5–7 μ in diameter, while those of *P. odora* are much smaller, only 2–4 μ.

I have not recently examined *P. broomei* as distributed by Rabenhorst (Fung. Eur. 2004), and specimens are not at present available. My judgment would be, however, that it represents what I have previously referred to *Polyporus rigidus* Lév. This plant is only rarely pileate, and when resupinate I find it very difficult to distinguish, microscopically and macroscopically, from thin light-colored forms of *P. nigrescens*.

STATE COLLEGE,
PENNSYLVANIA.

EXPLANATION OF PLATE I

Fig. 1. *P. nigrescens.* Microphotograph of cross-section of hymenium, × 160.

Fig. 2. Same, × 320, showing the absence of basidia in well-developed specimens; also the peculiar thick-walled hyphae that give a pseudo-cellular appearance to the trama.

Fig. 3. *P. ferruginosa.* Microphotograph of cross-section of the hymenium, × 160, showing the abundant setae.

Fig. 4. Same, × 320, showing the setae.

Fig. 5. *P. ambigua.* Microphotograph of cross-section of the hymenium, × 160.

Fig. 6. Same, showing the occasional cystidia as at *a*.

UREDINALES COLLECTED BY FRED J. SEAVER IN TRINIDAD *

J. C. Arthur

No attempt has heretofore been made to enumerate the rusts of Trinidad. The present list of 71 species makes a creditable beginning. Probably two or three times this number may be found when a more thorough exploration is made. Over 160 species are already known for the island of Porto Rico, and about the same number for Cuba. Porto Rico has not one tenth the area of Cuba, and Trinidad has not quite one half the area of Porto Rico, but has a diversified topography and nearness to the mainland that will doubtless largely compensate for lessened area.

The island of Trinidad lies so close to the coast of South America that it is more properly considered a part of the southern continent rather than of the northern. Its flora is excluded from the volumes of the North American Flora.

The collections made by Dr. Seaver were obtained during the six weeks between March 1 and April 14, 1921. The visit to the island was made in the company of Dr. N. L. Britton,[1] who supplied a preliminary determination of the hosts in the field. The hosts have since been checked over by Mr. Percy Wilson at the herbarium of the New York Botanical Garden.

It is worthy of note that although Dr. Seaver gave his chief attention to other groups of fungi, yet he was able to secure 169 collections of Uredinales, which have yielded 71 species of rusts, 3 being new, or 4 including the one supplied by Mr. Nowell, as well as quite a number that are little known.

In the following list space has been economized by omitting the exact localities, except for new species, and by referring to the page of the seventh volume of the North American Flora, where

* Contribution from the Botanical Department of Purdue University Agricultural Experiment Station.

[1] For a detailed account of this trip, see Journal of the New York Botanical Garden for May, 1921.

the synonymy can be found, so far as that work has been published. All collections, except the one noted, are to be credited to Dr. Seaver, and the date of collection is March–April, 1921. Numbers 26, 33, 39, 41, 46, 47, 50, 52–57, thirteen in all, or eighteen per cent, are short-cycle species, the remaining fifty-eight are various forms of long-cycle species.

1. COLEOSPORIUM IPOMOEAE (Schw.) Burr. N. A. F. 87

On *Ipomoea glabra* (Aubl.) Choisy, II, *3181, 3275, 3291; Ipomoea* sp., II, *3274, 3385*. A common rust in its uredinial stage throughout tropical America.

2. PHAKOPSORA CROTONIS (Cooke) Arth. N. A. F. 104

On *Croton gossypifolium* L., II, *3253, 3424; C. hirtus* L'Her., II, *3109*. This rust was described by P. Hennings (Hedwigia **35**: 251. 1896) under the name *Uredo crotonicola*, on *Croton grandulosus* from Argentina.

3. PHAKOPSORA MEIBOMIAE Arth. Bull. Torrey Club **44**: 509. 1917

On *Meibomia supina* (Sw.) Britton, II, *3197; M. triflora* (L.) Kuntze, II, *2960*.

4. CEROTELIUM GOSSYPII (Lagerh.) Arth. N. A. F. 187

On *Gossypium* sp., II, *2953, 3388*.

5. RAVENELIA INDIGOFERAE Tranz. N. A. F. 144

On *Indigofera suffruticosa* Mill. (*I. Anil* L.), *3077*.

6. PROSPODIUM APPENDICULATUM (Wint.) Arth. N. A. F. 160

On *Tecoma Stans* (L.) Juss., III, *3406, 3430*.

7. **Prospodium suppressum** sp. nov.

O. Pycnia amphigenous, numerous, blackish-brown, inconspicuous, subcuticular, conic, small, about 100 μ broad and about same height; ostiolar filaments wanting.

II. Uredinia at first (primary) amphigenous, interspersed with the pycnia in circular groups 2–4 mm. across on somewhat larger discolored spots, afterward (secondary) hypophyllous, scattered, minute, 0.1–0.2 mm. in diameter, soon naked, pulverulent, chestnut-brown; paraphyses few or wanting; urediniospores flattened laterally, seen from flattened side globoid or somewhat obovoid, 23–32 by 25–40 μ, seen from narrow side obovate, and apparently acute above; wall with a hygroscopic layer, the inner layer firm, cinnamon-brown, 3 μ thick, the cuticle and subcuticular layers colorless, verrucose-echinulate with close-set, blunt projections on the flattened sides, becoming much longer on the narrowed sides and, as the spores are ordinarily seen, appearing like a coarse fringe, 5–7 μ wide, extending around the spore, the pores 2, distinct, one in center of each flattened side.

III. Telia hypophyllous, in loose groups, at first bullate, soon naked, somewhat pulverulent, chocolate-brown, ruptured cuticle noticeable; teliospores ellipsoid, 21–24 by 25–34 μ, rounded above and below, slightly constricted at septum; wall dark chestnut-brown, uniformly 2–3 μ thick, sparingly and evenly verrucose; pedicel colorless, as long as spore, slender, tapering downward, the appendages obsolete.

On *Tabebuia* sp. (Bignoniaceae), Las Lilas, March 24–28, O, II, *3350* (type); Pointe Gourde, March 31, II, III, *3408;* Forest, Siparia Quarry, April 8, III, *3526;* Lady Chancellor Road, March 14, II, iii, *3180*. The group of species to which this new species belongs is imperfectly understood. There are probably quite a number of them, but at present the collections are frequently unnamed or listed under the genus *Uredo* or *Puccinia*, and have not been brought together for comparative study.

8. UROMYCES AFFINIS Wint. Hedwigia 24: 259. 1885

On *Hypoxis decumbens* L., II, *3192, 3199, 3387*. The aecia and telia of this species were found in Missouri in 1883 by Demetrio, the earliest collection of the rust known, but so few urediniospores were present that they were not mentioned in the original description. Since that time many collections showing abundance of uredinia have been taken in the eastern United States, and recently the tropical collections, which show only uredinia and are usually reported under the names *Uredo Hypoxidis* (Bres.) P. Henn. and *Uredo globulosa* Arth., have been referred to the same species.

9. Uromyces appendiculatus (Pers.) Fries, N. A. F. 257

On *Phaseolus* sp., *3249*.

10. Uromyces bidenticola (P. Henn.) Arth. Mycologia 9: 71. 1917

On *Bidens pilosa* L., II, *3075, 3190*.

11. Uromyces columbianus Mayor, Mém. Soc. Neuch. 5: 467. 1913

On *Melanthera aspera* (Jacq.) Steud., I, II, *3245;* II, *3239, 3301*.

12. Uromyces Dolicholi Arth. N. A. F. 258

On *Cajan Cajan* (L.) Millsp., *3028, 3335, 3487*.

13. Uromyces Hedysari-paniculati (Schw.) Farl. N. A. F. 248

On *Meibomia Scorpiurus* (Sw.) Kuntze, *3194; M. affinis* (Sch.) Kuntze, *3306*.

14. Uromyces Howei Peck, N. A. F. 264

On *Asclepias Curassavica* L., II, *3304*.

15. Uromyces Janiphae (Wint.) Arth. Mycologia 7: 190. 1915

On *Manihot Manihot* (L.) Cockerell, II, *3268, 3279, 3423*. Uredinia of this rust are common in tropical America, but the aecia and telia have only been found in Mexico.

16. Uromyces leptodermus Sydow, N. A. F. 224

On *Lasaicis* sp., II, *3402, 3477*.

17. Uromyces major Arth. (*Uredo ignobilis* Arth.), N. A. F. 225

On *Sporobolus indicus* (L.) R. Br., II, *3093*.

18. Uromyces Neurocarpi Diet. N. A. F. 258

On *Clitoria rubiginosa* Juss., II, III, *3206, 3292*.

19. Uromyces proëminens (DC.) Pass., N. A. F. 259

On *Chamaesyce hirta* (L.) Millsp., *2965, 2973, 3302, 3436, 3528*.

20. UROMYCES SCLERIAE P. Henn. N. A. F. 233

On *Scleria melaleuca* Schlecht. & Cham., II, *3299*. It has been reported from Cuba, Porto Rico, and southern Brazil.

21. UROMYCES WULFFIAE-STENOGLOSSAE Diet. Ann. Myc. **6**: 96. 1908

On *Wulffia baccata* (L. f.) Kuntze, I, *2971;* II, iii, *3244;* I, II, iii, *3231*.

22. PUCCINIA ACNISTI Arth. N. A. F. 471

On *Acnistus arborescens* Schlecht., I, *3178, 3227, 3524*.

23. PUCCINIA AEQUINOCTIALIS Holway, Ann. Myc. **3**: 22. 1905

On *Cydista aequinoctialis* (L.) Miers, II, *3092*.

24. PUCCINIA ANGUSTATOIDES R. E. Stone, N. A. F. 351

On *Rynchospora cyperoides* (Sw.) Mart., III, *2976*.

25. PUCCINIA ANTIOQUIENSIS Mayor, N. A. F. 347

On *Cyperus diffusus* Vahl, II, iii, *3337, 3393;* III, *3269*. The three collections show many 1-celled teliospores (mesospores), and the few teliospores found on *3337* and *3393* were all 1-celled, which would entitle these two collections to be entered under the genus *Uromyces*. The number of teliospores present are too few, however, to warrant the introduction of a new name.

26. PUCCINIA ARECHAVALETAE Speg. An. Soc. Ci. Arg. **12**: 67. 1881

On *Urvillea Seriana* (L.) H. B. K., *2966, 3133, 3139, 3345, 3479*.

27. PUCCINIA BIGNONIACEARUM Speg. An. Soc. Ci. Arg. **26**: 11. 1888

On *Bignoniaceae*, III, *3333, 3378*.

28. PUCCINIA CANNAE (Wint.) P. Henn. N. A. F. 380

On *Canna* sp., II, *3105, 3201, 3483; Maranta arundinacea* L., II, *2969, 3091, 3138, 3141, 3476*. The latter host has not before been reported.

29. PUCCINIA DEFORMATA Berk. & Curt. N. A. F. 294

On *Olyra latifolia* L., ii, III, *3474*.

30. PUCCINIA EUPATORII-COLUMBIANI Mayor, Mém. Soc. Neuch. 5: 514. 1913

On *Eupatorium inulaefolium* H. B. K., II, III, *3587*.

31. PUCCINIA GOUANIAE Holway, Ann. Myc. 3: 21. 1905

On *Gouania polygama* (Jacq.) Urban, II, *3027, 3457, 3090, 3254;* II, III, *3478, 3117*.

32. PUCCINIA HELICONIAE (Diet.) Arth. Bull. Torrey Club 45: 144. 1918

On *Heliconia psittacorum* (L. f.) Kuntze, II, *3202; Heliconia* sp., II, *3525*.

33. PUCCINIA HETEROSPORA Berk. & Curt. Jour. Linn. Soc. 10: 356. 1868

On *Abutilon giganteum* (Jacq.) Presl, *3458*.

34. PUCCINIA HYDROCOTYLES (Link) Cooke, Grevillea 9: 14. 1880

On *Hydrocotyle Hazeni* Rose, II, *3426*.

35. PUCCINIA HYPTIDIS (M. A. Curt.) Tr. & Earle, N. A. F. 408

On *Hyptis capitata* (L.) Jacq., II, *2968*.

36. PUCCINIA HYPTIDIS-MUTABILIS Mayor, N. A. F. 410

On *Hyptis mutabilis* (A. Rich.) Briq., I, *3074, 3386;* II, *3107, 3189*.

37. **Puccinia** (?) **ignava** comb. nov. (*Uredo ignava* Arth.), N. A. F. 341

On *Bambos* sp., II, *2958, 3111*. Although the teliospores of this species are not known, it is highly probable that they will eventually be found to conform to the requirements of the genus *Puccinia,* and for convenience it is now so listed.

38. PUCCINIA IMPEDITA Mains & Holway; Arth. Mycologia 10: 135. 1918

On *Salvia occidentalis* Sw., II, *2962, 3272*.

39. PUCCINIA LANTANAE Farl. Proc. Am. Acad. Sci. 18: 83. 1883

On *Priva lappulacea* (L.) Pers., *2955, 2970, 3397*.

40. PUCCINIA LEONOTIDIS (P. Henn.) Arth. N. A. F. 407

On *Leonotis nepetaefolia* (L.) R. Br., II, *3273, 3354*.

41. PUCCINIA OBLIQUA Berk. & Curt.; Berk. Jour. Linn. Soc. 10: 356. 1869

On *Metastelma* sp., *3188, 3448, 3488*.

42. PUCCINIA PALLESCENS Arth. (*Uredo pallida* D. & H.), N. A. F. 278

On *Zea Mays* L., II, *3103, 3110*. No teliospores of this rust have yet been found on corn (maize), and the aecia are unknown.

43. PUCCINIA RUELLIAE (Berk. & Br.) Lagerh. N. A. F. 415

On *Blechum Blechum* (L.) Millsp. (*B. Brownei* Juss.), II, *2957, 3096, 3195; Diantha pectoralis* (Jacq.) Gmel. (*Justicia pectoralis* Jacq.), II, *2954, 3191*. The second host is a new record for the species.

44. PUCCINIA SCLERIAE (Paz.) Arth. (*Aecidium passifloricola* P. Henn.) N. A. F. 349

On *Passiflora rubra* L., I, *3422*.

45. **Puccinia Seaveriana** sp. nov.

II. Uredinia amphigenous, sparsely grouped or singly on yellowish spots, irregularly rounded, 0.1–0.5 mm. across, at first bullate, soon naked, somewhat pulverulent, cinnamon- or chestnut-brown, ruptured epidermis conspicuous; paraphyses peripheral, abundant, strongly incurved, cylindric, sometimes inclined toward capitate, 10–15 by 40–50 μ, the wall thin, 1 μ, and pale or colorless below, much thickened above, 3–6 μ, and dark chestnut-brown; urediniospores broadly ellipsoid or globoid, 16–22 by 18–27 μ; wall cinnamon-brown, thin, 1–1.5 μ, closely and conspicuously echinulate, the pores 3, equatorial.

III. Telia not seen; teliospores in the uredinia oblong, 25–30 by 40–45 μ, rounded above and below, slightly or not constricted at septum; wall dark chestnut-brown, uniformly thick, about 3 μ, closely and noticeably verrucose; pedicel colorless, slender, fragile, once length of spore or shorter.

On *Oliganthes condensatus* (Less.) Schr. Bip. (*Carduaceae*), Lady Chancellor Road, March 14, II, *3179;* same, March 17, II, *3236;* same, March 21, II, *3283* (type); *Oliganthes Milleri*(?), western end of Monos Island, April 4, II, iii, *3459*. The hosts belong to the tribe Vernonieae, and are part of a genus comprising about eight species confined to tropical America. All the species are trees or shrubs, *Oliganthes condensatus* producing the largest individuals known among the composites. The rust is notable for its abundance of deeply colored paraphyses. Such structures have been recorded for only one other species on the tribe Vernonieae. Only a few teliospores were found. The type for the species has been chosen to show the most characteristic and best development of the uredinia, although the presence of teliospores could not be demonstrated. The few teliospores seen were on a collection which also had but few uredinia. The specific name is selected to give recognition to the devotion of the collector of this and other material which is the basis of this report, by which he has added greatly to the store of mycological knowledge.

46. **Puccinia solanita** (Schw.) comb. nov. (*Aecidium solanitum* Schw. Jour. Acad. Sci. Phila. II, **2**: 283. 1853; *Puccinia claviformis* Lagerh. Tromsö Mus. Aarsh. **17**: 53. 1895)

On *Solanum* sp., *3295*. The type collection for *Aecidium solanitum* is amply represented in the Schweinitz herbarium at the Philadelphia Academy of Science. An examination of this material shows that it bears a short-cycle rust, identical in appearance with *Puccinia claviformis*. The collection has also been examined by Mr. Percy Wilson and Dr. J. K. Small of the New York Botanical Garden, and they pronounce the host to be a species of *Solanum*, possibly *S. Melongena* L.

47. PUCCINIA SPEGAZZINII DeToni in Sacc. Syll. **7**: 704. 1888

On *Mikania micrantha* H. B. K., *3527; Mikania* sp., *2956, 3135, 3228, 3312.*

48. PUCCINIA STRIOLATA (Speg.) Arth. (*P. macropoda* Speg.) N. A. F. 387

On *Iresine Celosia* L., I, II, *3137*.

49. PUCCINIA SUBSTRIATA Ell. & Barth. N. A. F. 289

On *Eriochloa punctata* Ham., II, *3193*.

50. PUCCINIA SYNEDRELLAE P. Henn. Hedwigia **37**: 277. 1898

On *Synedrella nodiflora* (L.) Gaertn., *2964, 3271, 3586; Emilia sonchifolia* (L.) DC., *3073*.

51. PUCCINIA TUBULOSA (Pat. & Gaill.) Arth. (*Uredo paspalicola* P. Henn.) N. A. F. 288

On *Paspalum paniculatum* L., ii, *3112; Paspalum* sp., II, *2961, 3185; Syntherisma digitata* Hitchc., II, *3339*. The aecia of this species occur on *Solanum torvum* and closely related hosts.

52. PUCCINIA URBANIANA P. Henn. Hedwigia **37**: 278. 1898

On *Valerianodes cayennensis* (Vahl) Kuntze, *2967, 2972, 3255*.

53. ENDOPHYLLUM CIRCUMSCRIPTUM (Schw.) Whetzel & Olive, Am. Jour. Bot. **4**: 49. 1917

On *Cissus sicyoides* L., *3267*.

54. ENDOPHYLLUM DECOLORATUM (Schw.) Whetzel & Olive, l. c.

On *Clibadium surinamense* L., *3177, 3270*.

55. ENDOPHYLLUM WEDELIAE (Earle) Whetzel & Olive, l. c.

On *Wedelia trilobata* (L.) Hitchc., *3087*.

56. ENDOPHYLLOIDES PORTORICENSIS Whetzel & Olive, l. c.

On *Mikania* sp., *3136, 3523*.

57. PUCCINIOSIRA PALLIDULA (Speg.) Lagerh. N. A. F. 127

On *Triumfetta* sp., *3079, 3248b, 3252, 3310*.

58. UREDO ADENOCALYMMATIS P. Henn. Hedwigia **35**: 249. 1896

On Bignoniaceae, *3203, 3340*. This rust, both in its spores and paraphyses, has a close resemblance to species which have been

referred to the genus *Prospodium*. The paraphyses are notable for their scimitar shape, sharp points, and cross walls. It has been reported on *Pyrostegia venusta*, as well as on the type genus.

59. UREDO COMMELYNAE Kalchbr. Grevillea **11**: 24. 1882
On *Commelina elegans* H. B. K., *3390*.

60. UREDO CYATHULAE Mayor, Mém. Soc. Neuch. **5**: 584. 1913
On *Cyathula achyranthoides* (H. B. K.) Moq., *3334*.

61. UREDO MACULANS Pat. & Gaill. Bull. Soc. Myc. Fr. **4**: 98. 1888
On *Pfaffia iresinoides* (H. B. K.) Kuntze, *3076, 3250, 3303*.

62. UREDO MANDEVILLAE Mayor, Mém. Soc. Neuch. **5**: 591. 1913
On *Mandevilla tomentosa* (Vahl) Kuntze, *3258, 3285, 3297*.

63. UREDO RUBESCENS Arth. Mycologia **7**: 327. 1915
On *Dorstenia Contrajerva* L., *3078, 3475*.

64. UREDO TRICHILIAE Arth. Mycologia **9**: 90. 1917
On *Trichilia trinitensis* A. Juss., *3305, 3421*.

65. UREDO VICINA Arth. Mycologia **7**: 325. 1915
On *Wedelia Jacquini* Rich., *3432*.

66. UREDO VITICIS Juel, Bih. K. Sv. Vet.-Akad. Handl. **23**(3)[10]: 26. 1897
On *Vitex* sp., *3293*.

67. **Aecidium Alibertiae** sp. nov.

O. Pycnia epiphyllous, numerous in circular groups on discolored spots 4–10 mm. across, prominent, subepidermal but appearing subcuticular, flattened-conic, large, 160–210 μ in diameter, 65–80 μ high; hymenium flat; ostiolar filaments wanting.

I. Aecia hypophyllous, opposite the pycnia, short-cylindric, 0.3–0.4 mm. in diameter, deep-seated, extending half way through the leaf; peridium colorless, the margin coarsely lacerate, fragile; peridial cells in front view angularly ellipsoid or oblong, in side view lanceolate, strongly overlapping, 16–20 by 30–40 μ, the outer wall thin, 1–2 μ, smooth, the inner wall thicker, 2–5 μ, moderately

and closely verrucose; aeciospores globoid, 21–26 by 23–29 μ; wall pale or cinnamon-brown, 1.5–2 μ thick, finely and closely verrucose.

On *Alibertia* sp. (Rubiaceae), Piarco savanna, March 15, *3204*; Piarco savanna, south of Dabadie, March 21, *3286* (type); Meara savanna, March 22, *3296*. The species is remarkable for the large pycnia, that are formed beneath the thin epidermis, but above the thick palisade cells. They are morphologically similar to subcuticular pycnia.

68. AECIDIUM BRASILIENSE Diet. Hedwigia 36: 35. 1897

On *Cordia cylindrostachya* R. & S., *3106, 3246, 3251, 3277*.

69. AECIDIUM BYRSONIMATIS P. Henn. Hedwigia 34: 101. 1895

On *Byrsonima verbascifolia* Rich. (?), *3200*.

70. **Aecidium delicatum** sp. nov.

O. Pycnia amphigenous, in small close groups, punctiform, honey-yellow, noticeable, subepidermal, globoid, about 125 μ in diameter.

I. Aecia hypophyllous, surrounding the pycnia, somewhat circinating, on yellowish spots 1–2 mm. across, low and broad, 0.5–0.8 mm. in diameter; peridium delicate, erect, finely erose; peridial cells oblong in surface view, rhomboidal in side view, slightly overlapping, 26–32 μ long, the wall colorless, the inner wall 3–5 μ thick, finely verrucose, the outer wall thinner, smooth; aeciospores globoid or ellipsoid, 16–24 by 20–30 μ; wall colorless, thin, 1 μ, minutely and closely verrucose.

On *Eucharis* sp. (Amaryllidaceae), Port of Spain, no date, collected by Nowell and communicated by Seaver. Little comparative study has been made of the rusts on Amaryllidaceous hosts. Their identity is made especially difficult by the collection of single stages and on hosts not fully determined.

71. AECIDIUM TOURNEFORTIAE P. Henn. Hedwigia 34: 338. 1895

On *Tournefortia tomentosa* Mill., *3278*.

INDEX TO UREDINALES

(New or newly combined names are in **bold face** type)

HOST INDEX

PURDUE UNIVERSITY,
LAFAYETTE, INDIANA.

ILLUSTRATIONS OF FUNGI—XXXIII

William A. Murrill

(With Plates 2–9)

The last article of this series, devoted to *Boletus luteus, Tylopilus alboater,* and *Armillaria nardosmia,* appeared in *Mycologia* for March, 1920. To illustrate the species included in the present article, I shall use photographs made from the fresh specimens.

Chanterel floccosus Schw.

Floccose Chanterel

Plate 2. × ¼

Pileus elongated trumpet-shaped to funnel-shaped, closed at the top when very young, becoming deeply infundibuliform, firm, fleshy, gregarious to subcespitose, 5–14 cm. broad, 10–18 cm. high; surface floccose, with persistent or evanescent scales, bright-yellow when young, some shade of orange when mature, fading at times; margin concolorous, rarely tinged with lilac, undulate, involute when dry; context thin, white, sweet, edible; hymenium cremeous at first, then ochraceous, rarely pale-umber tinged with lilac, finally ochraceous-brown throughout; lamellae thick, close, narrow, decurrent, repeatedly forked, branching or anastomosing; spores ellipsoid, smooth, ochraceous, $14 \times 7\,\mu$; stipe short, glabrous or hairy, whitish at the base when young, becoming cremeous or ochraceous.

This species, which was originally described from the Pocono Mountains in Pennsylvania, is large, handsome, and edible. It is to be looked for in damp places in dense woods throughout most of the eastern United States, occurring from Maine to Alabama and west, even to Oregon and Washington. It can not be called common, although I have at times found it fairly abundant in favored spots. The illustration is taken from a handsome photograph made in October, 1921, at Mount Vernon, New York, by Mr. A. W. Dreyfoos, and donated by him to the Garden herbarium. It shows well the peculiar and characteristic appearance of the surface of the pileus in its younger stages.

Clitocybe phyllophila (Pers.) Quél.

LEAF-LOVING CLITOCYBE

Plate 3. × 1

Pileus fleshy, convex or plane, becoming depressed or umbilicate, obtuse, solitary or cespitose, 4–7 cm. broad; surface smooth, dry, white, silvery on the margin because of the silky veil; lamellae moderately broad, subdistant, adnate or slightly decurrent, white, becoming yellowish-ochraceous; spores ellipsoid, 6–8 x 3–5 μ; stipe equal, stuffed or hollow, tough, downy and incurved at the base, spongy within, white, sometimes eccentric, 5–7 cm. long, 5–8 mm. thick.

A well-known European species found in the eastern United States from New England to North Carolina and west to Wisconsin. As its name implies, it is fond of fallen leaves and sticks in woods. Peck does not list it as edible and I have not experimented with it, but when it has been tried out it will very probably be found among the edible species. The photograph was made from plants collected at Stockbridge, Massachusetts, October 3, 1911.

Clitocybe subhirta Peck

SLIGHTLY-HAIRY CLITOCYBE

Plate 4. × 1

Pileus convex or nearly plane, sometimes slightly depressed, 2.5–7 cm. broad; surface at first hairy-tomentose, then nearly glabrous, pale-yellow or buff, becoming whitish, margin incurved; lamellae crowded, adnate or decurrent, whitish or pale-yellow; spores subglobose, 4–5 μ; stipe nearly equal, stuffed or hollow, sometimes eccentric, 2.5–5 cm. long, 6–10 mm. thick.

A rare species, described from Brewerton, New York, and known only from this state and Massachusetts. Its edible qualities have not been tested. The photograph was made from plants collected at Stockbridge, Massachusetts, in October, 1911.

Melanoleuca Thompsoniana Murrill

THOMPSON'S MELANOLEUCA

Plate 5. × 1

Pileus large and attractive, convex to plane with a broad umbo,

sometimes splitting with age, gregarious, reaching 10 cm. broad; surface dry, glabrous, somewhat rimose, flavous over the whole surface when young, becoming dark-luteous at the center and flavous or cream-colored toward the margin; context thin, white or yellowish; lamellae adnate, becoming slightly sinuate and seceding, rather crowded and narrow, lemon-yellow when young, becoming flavo-luteous with age, brownish on drying; spores subglobose, smooth, hyaline, 5–7 μ; stipe long, equal, longitudinally striate, glabrous, lemon-yellow, fleshy, firm, 14 cm. long, 2–2.5 cm. thick.

An attractive yellow species described by Peck in 1873 from Bethlehem, New York, as *Agaricus flavescens,* but this name had already been assigned to a species of *Agaricus* by Wallroth forty years before. It has been found on and about old pine stumps in New York, Massachusetts, and North Carolina. So far as I know, it has not been tested for edibility. The photograph was made from plants collected by Dr. Thompson and myself at Stockbridge, Massachusetts, October 3, 1911.

Melanoleuca eduriformis Murrill

RATHER-TOUGH MELANOLEUCA

Plate 6. × ¾

Pileus rather thin, becoming expanded or slightly depressed, gregarious to subcespitose, reaching 10 cm. broad; surface smooth, glabrous, polished, hygrophanous when wet, not viscid, isabelline to fulvous, scarcely darker at the center; margin concolorous, somewhat lobed; context white, with fragrant odor and very pleasant, mealy to nutty flavor; lamellae sinuate, rather narrow, crowded, white, unchanging; spores ellipsoid, smooth, hyaline, 5–6 x 2–3 μ; stipe larger above or below, rather irregular, pale-yellowish, white at the apex, smooth, glabrous, hollow, 8 cm. long, 1.5–2 cm. thick.

Described and known only from specimens collected in moist leaf-mold in the New York Botanical Garden, August 29, 1911. The illustration is from these specimens, which were not tested for edibility.

Galerula Hypni (Batsch) Murrill

MOSS-LOVING GALERULA

Plate 7. × 1

Pileus thin, membranous, subconic or campanulate, obtuse or

papillate, 5–15 mm. broad; surface glabrous, hygrophanous, watery-cinnamon or subochraceous and striatulate when moist, becoming paler when dry, often fading to yellowish or buff; margin usually striate; lamellae thin, broad, distant, adnate, ventricose, white or whitish, becoming ochraceous-yellow, often whitish-floccose on the edges; spores ovoid, pointed, smooth, uniguttulate, 8–12 x 5–7 μ; cystidia flask-shaped, 40–45 μ long, 8–10 μ thick at the base; stipe slender, flexuous, hollow, smooth or slightly silky-fibrillose, downy or pruinose at the apex, with a white mycelioid tomentum at the base, whitish or pallid, varying to fuliginous, 2.5–5 cm. long, about 1 mm. thick; veil slight, evanescent.

A dainty little plant occurring commonly among mosses or grasses in shaded places throughout Europe and temperate North America and occasionally found on high mountains in tropical America. The specimens figured were collected in the New York Botanical Garden in August, 1911.

Gymnopilus flavidellus Murrill

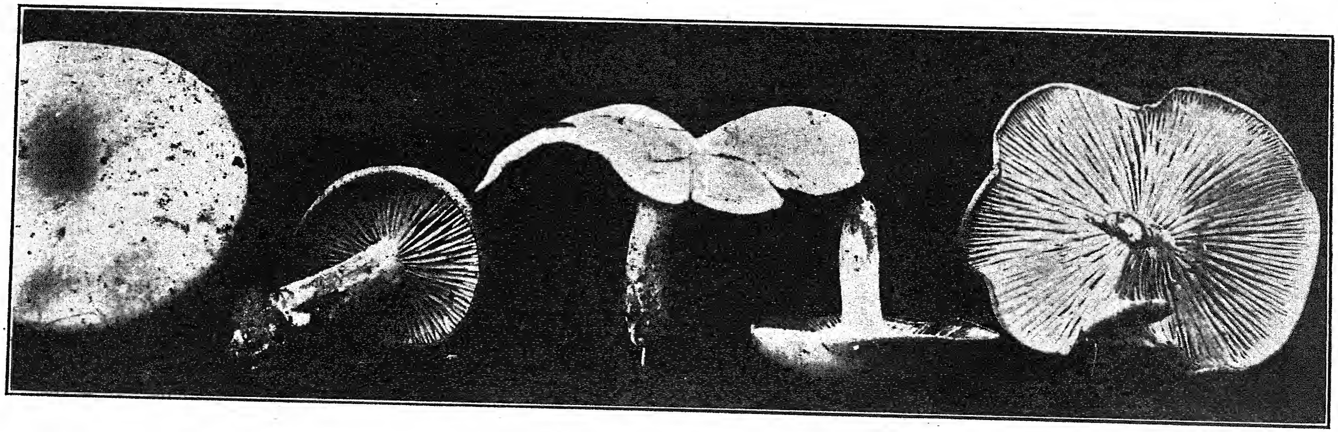
YELLOWISH GYMNOPILUS

Plate 8. × 1

Pileus convex to plane or slightly depressed, gregarious or subcespitose, 3–5 cm. broad; surface dry or moist, smooth, glabrous, not striate, melleous to ochraceous or luteous at the center; margin entire, cream-colored; context yellowish, with mawkish, slightly bitter taste; lamellae adnate or sinuate with a decurrent tooth, rather crowded and narrow, pale-yellow to ferruginous; spores ovoid, minutely echinulate, ferruginous, 8–9 x 5–6 μ; stipe subequal, solid to hollow, pale-yellow to yellowish-brown, pruinose at the apex, whitish-mycelioid at the base, 3–5 cm. long, 3–5 mm. thick; veil arachnoid, fugacious.

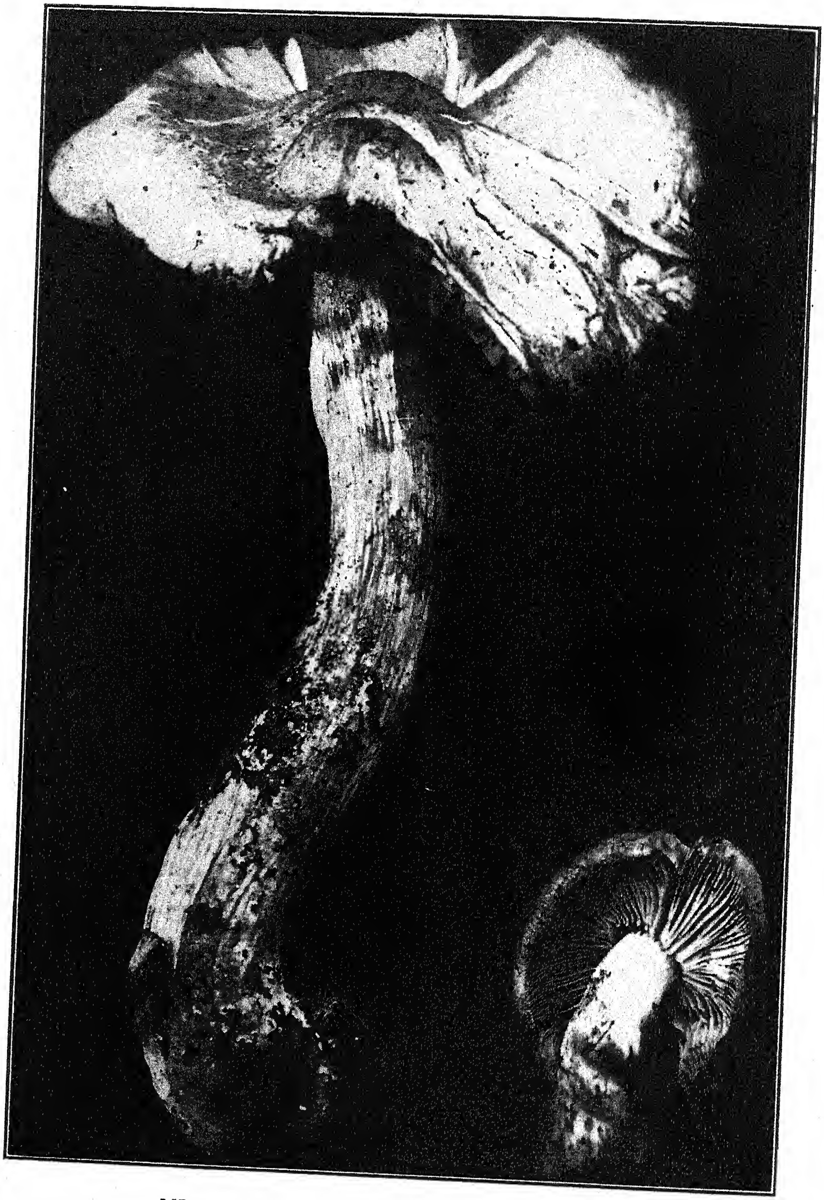
Described and figured from specimens collected on a chestnut stump in woods in the New York Botanical Garden, September 9, 1911. It occurs on dead wood of various deciduous and coniferous trees throughout most of temperate North America and has been found also in Bermuda. Species of this genus have not been sufficiently tested for edibility and should be avoided for the present. Some of them are known to be poisonous.

CHANTEREL FLOCCOSUS SCHW.

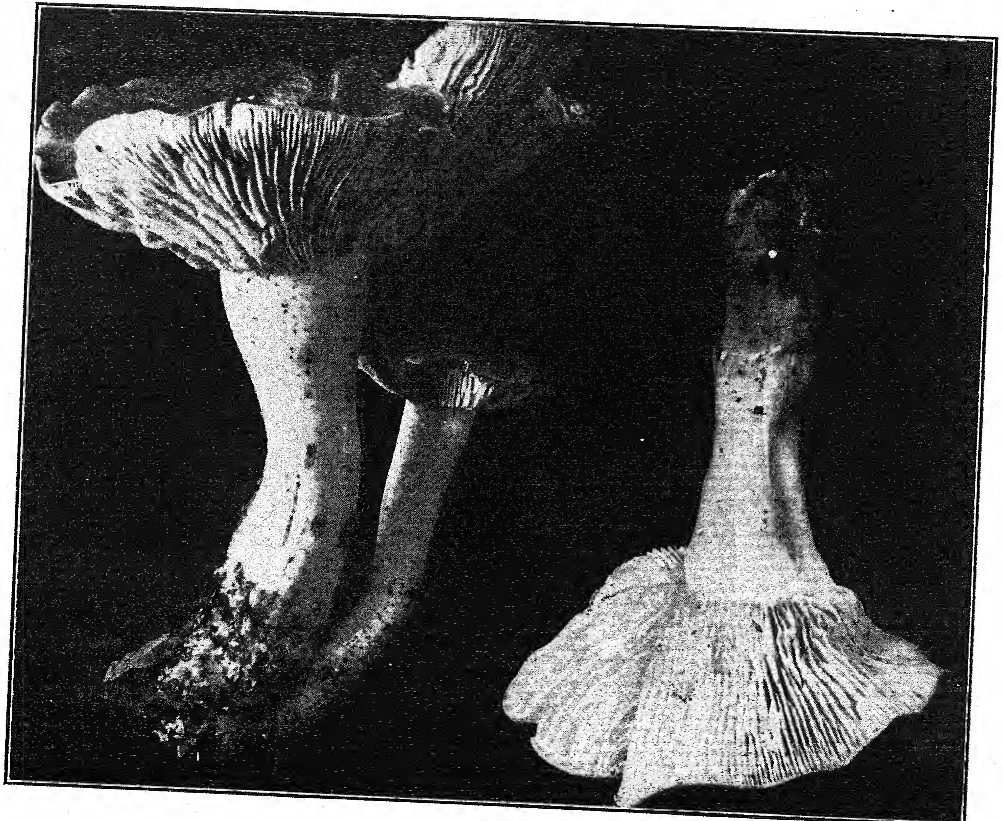


CLITOCYBE PHYLLOPHILA (PERS.) QUÉL.

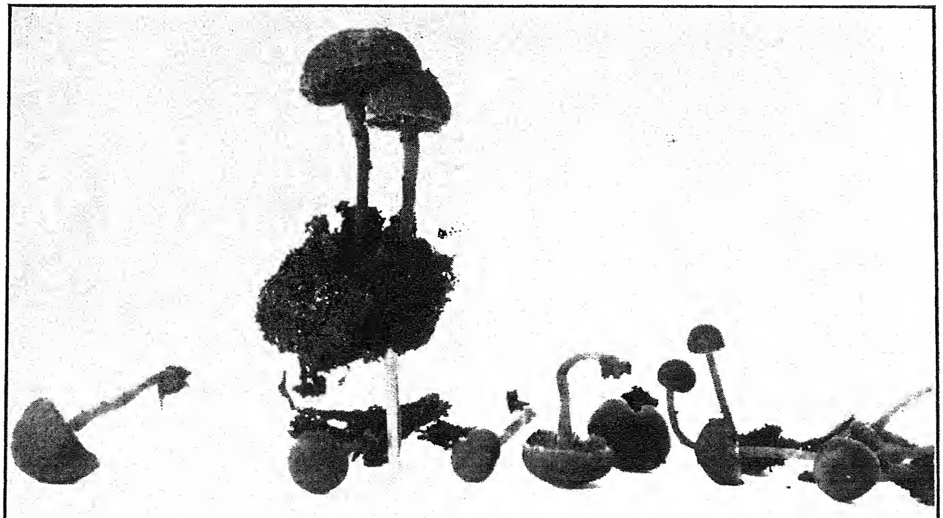
CLITOCYBE SUBHIRTA PECK



MELANOLEUCA THOMPSONIANA MURRILL

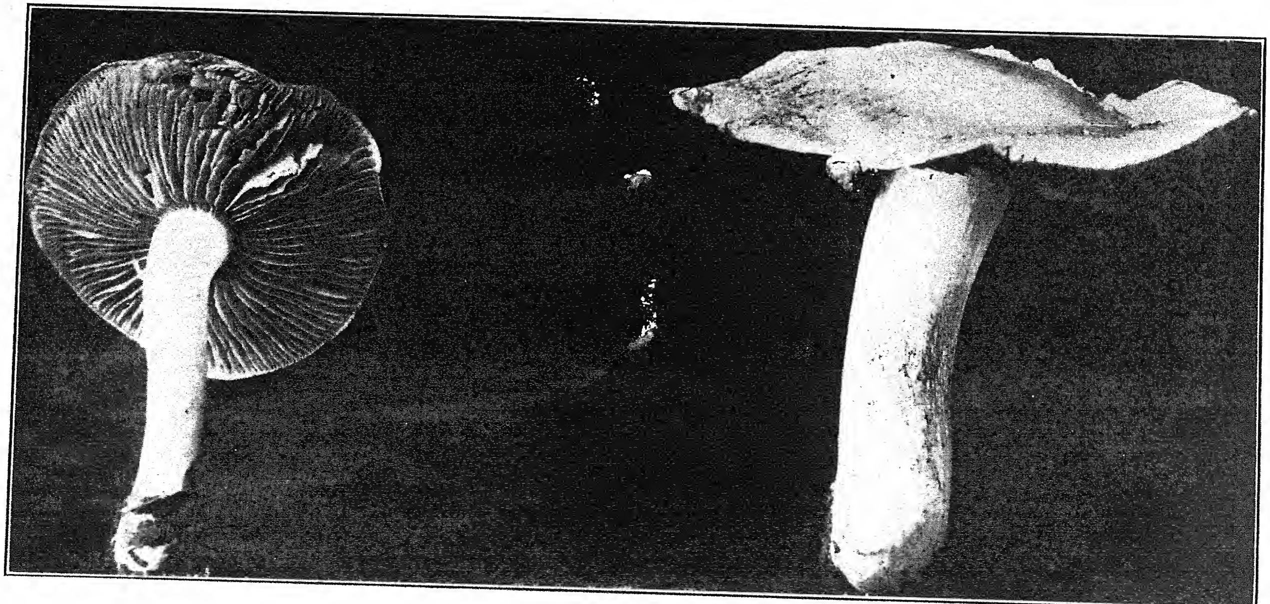


MELANOLEUCA EDURIFORMIS MURRILL



GALERULA HYPNI (BATSCH) MURRILL

GYMNOPILUS FLAVIDELLUS MURRILL



HEBELOMA LUTEUM Murrill

Hebeloma luteum Murrill

EGG-YELLOW HEBELOMA

Plate 9. × 1

Pileus large, thick, fleshy, convex to plane, solitary, 5–10 cm. broad; surface smooth, glabrous, viscid, luteous; margin ochraceous, entire, not striate; lamellae sinuate, ventricose, crowded, melleous to ferruginous; spores ellipsoid, smooth, subfulvous in mass, melleous under the microscope, 7–8.5 x 4–5 μ; stipe equal or tapering upward, smooth, dry, glabrous, pearly-white, 5–7 cm. long, 7–15 mm. thick; veil fibrillose, slight, evanescent.

Described, figured, and known only from specimens collected on the ground in woods near Stockbridge, Massachusetts, early in September, 1911. This is another genus that is too difficult and too imperfectly known as yet to be recommended to amateur mycophagists.

NEW YORK BOTANICAL GARDEN.

THE OPHIOBOLUS CAUSING TAKE-ALL OF WHEAT

H. M. Fitzpatrick, H. E. Thomas, and R. S. Kirby

(With Plate 10 and 1 Text Figure)

The discovery of perithecia of a species of *Ophiobolus* in July, 1920, at East Rochester, New York, on wheat plants showing characteristic symptoms of the take-all disease was reported in an earlier paper.[1] Subsequently additional collections of the fungus have been made in scattered localities in New York, and reports of its occurrence in other states have been received. The fungus has also been obtained in pure culture, and repeated inoculations have demonstrated it to be the causal organism of the take-all disease. Normal perithecia with mature asci and spores have developed in culture, and a comparative study shows the organism used in the inoculations to be identical with that collected in the field. A paper dealing with the various aspects of the experimental work and embracing a discussion of the parasitism of the fungus has been submitted for publication.[2] In the present paper only facts bearing on the identity of the organism are considered.

In the historical and bibliographic discussion of the take-all disease prepared by Stevens[3] a number of papers are cited in which the discovery of perithecia of *Ophiobolus* in connection with diseased plants is reported. Two species, *O. graminis* Sacc. and *O. herpotrichus* (Fr.) Sacc., are mentioned repeatedly. It has seemed necessary to compare our fungus carefully with these and other species of *Ophiobolus* occurring on grasses, as well as with various

[1] Kirby, R. S., and Thomas, H. E. The take-all disease of wheat in New York. Science, N. S. 52: 368–369. 1920.

[2] Kirby, R. S. The take-all disease of cereals and grasses. Phytopathology for January, 1922. (Abstract of paper presented at annual meeting of Phytopathological Society at Toronto, December 28, 1921. Complete paper not yet published.)

[3] Stevens, F. L. Foot-rot disease of wheat—historical and bibliographic. Bull. Nat. Hist. Survey. Illinois Dept. Registration and Education 13: 259–286. 1919.

foreign collections of *Ophiobolus* associated with the take-all disease. Moreover, the economic importance of the disease has made desirable the publication of an illustrated description of the fungus for the use of those who are searching in various sections of the country for infected plants. This is particularly true since the published descriptions of grass-inhabiting species of *Ophiobolus* in most cases are brief and more or less inadequate.

Through the coöperation of several foreign correspondents the comparison of the American collections of the fungus with material from other countries has been accomplished. Specimens of *Ophiobolus* on wheat from three different localities in England were mailed for our examination by Doctor Cotton. Three collections on wheat and barley from various parts of Japan were submitted by Doctor Miyabe, one on barley from Italy was received from Professor Peglion and Mattirola, and a single collection from France was sent by Professor Foex. In all cases the fungus had been found associated with the typical symptoms of the take-all disease, and in every instance the material was labeled *O. graminis* Sacc. A critical examination of the various collections, including a comparative study of perithecia, asci, and spores, shows the fungus to be identical in every case with the American material. Furthermore, specimens collected in New York have been submitted to Professor McAlpine, and he writes: "I have carefully examined the specimens sent by you and on comparing the mycelium, perithecia, and spores have come to the conclusion that it is the same fungus as that occurring on Australian wheat." There can be no question, therefore, of the propriety of applying the name take-all to the disease of wheat in this country.

The fungus agrees in general with the descriptions of *O. graminis* given by Saccardo,[4, 5] and with the description and figures of this species published by Berlese.[6] There are certain minor points of difference, and for this reason the examination of the original collection is desirable. However, the herbarium of Saccardo has been practically unavailable since his death, the col-

[4] Saccardo, P. A. Fungi veneti novi vel critici. ser. II. Nuovo Giornale Botanico Italiano **7**: 307. 1875. (*Rhaphidophora graminis* Sacc.)

[5] Saccardo, P. A. Sylloge fungorum **2**: 349. 1883.

[6] Berlese, A. N. Icones Fungorum **2**: 119–120. Pl. 146, fig. 2. 1899.

lections having been kept in his home pending the action of the administrator of the estate. Through the kindness of Professor O. Mattirola it nevertheless has been possible to get in touch with the son, Professor D. Saccardo, and he has visited the herbarium and mailed us a fragment of material from a specimen labeled "*Ophiobolus graminis* exempl. Mad. Libert." This is probably the type collection, as the species was based on material in the herbarium of Libert.[7] Unfortunately, however, the material submitted is worthless, since it bears no perithecia of *Ophiobolus*. A second attempt to obtain material has been made, but has not yet proved successful. It is hoped that it will be possible to publish in a subsequent note information concerning the type specimen, but until the herbarium is made more readily available this may not be possible.

Berlese states that he examined the original collection of *O. graminis* in the herbarium of Saccardo, and that the figures of perithecia, asci, and spores given by him were drawn from it. His drawings of the perithecium indicate that the organism studied is identical with our own, and although the spores as figured by him are more slender than those of the take-all fungus, it is probable that they were drawn inaccurately, since they do not correspond with his description. In fact, his measurements of perithecia, asci, and spores agree so closely with those obtained by us for the take-all organism that its identity with *O. graminis* can hardly be questioned. His failure to mention paraphyses, and his statement that the spores are only tri-septate, are probably due to his having seen only a small amount of relatively unfavorable herbarium material. Since his description agrees with that of Saccardo, there seems to be no reasonable justification for questioning his statement that the figures were drawn from the type collection. He asserts further that he compared this material with the type collections of *Sphaeria eucrypta* Berk. & Br. and *S. cariceti* Berk. & Br. and found the three species to be identical. Moreover, he accepts the oldest specific name and designates the species as *O. eucryptus* (Berk. & Br.) Sacc.

[7] Roumeguere, C., et Saccardo, P. A. Reliquiae mycologicae Libertianae, series altera. Revue Mycologique 3: No. 11. 39–59. Pl. 19, 20. 1881.

In the endeavor to corroborate Berlese's statements an attempt has been made to obtain from the herbarium of the Royal Botanic

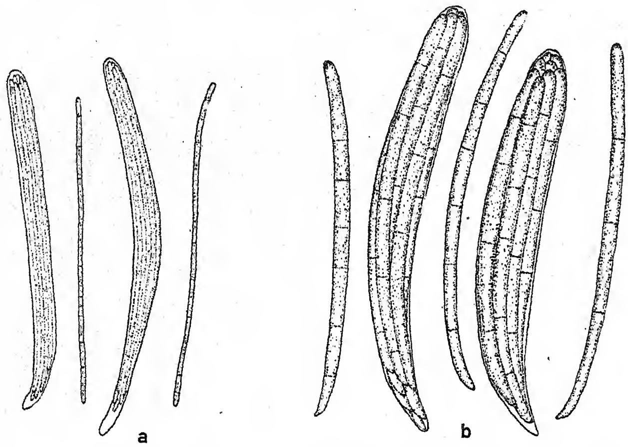


FIG. 1. *a,* Asci and spores of *Ophiobolus eucryptus,* from material collected by Broome on *Iris foetidissima.* × 625; *b,* Asci and spores of *O. cariceti,* from material collected in New York on wheat showing typical symptoms of the take-all disease. × 625. (Camera lucida)

Gardens at Kew portions of the original collections of these two British specimens. Since both species antedate *O. graminis,* the demonstration of the correctness of Berlese's assertion with reference to either would force us to discard the specific name *graminis.*

Miss Wakefield has very obligingly mailed to us from Kew material bearing on this nomenclatorial problem, and accompanying the material has written as follows:

"*Sphaeria eucrypta* B. & Br. There seems to be no type of this (on *Carex pendula*) in existence. We have 5 specimens collected by Broome, but all are on *Iris foetidissima.* I send you a slide of one of these—collected at Batheaston, Jan., 1859.

"*Sphaeria cariceti* B. & Br. The type of this in Berkeley's own herbarium (Batheaston, Dec., 1858) does not seem to have any mature perithecia left. I found some in another specimen from Cooke's herbarium collected by Broome. This is labelled in Broome's handwriting 'on *Aira caespitosa,* Batheaston, Jan., 1850,' but the name '*Sphaeria cariceti* B. & Br.' has been added at another time in rather different handwriting, which I doubt being that of

Broome. However, there are no specimens in Broome's herbarium at the British Museum,—so I am sending you a slide of this one, as it seems probably authentic."

In addition to the slides showing asci and spores, fragments of leaf sheaths showing perithecia were also sent to us, and a careful comparison of these specimens with material of the take-all organism was made.

The perithecia of *S. cariceti* as shown in the type specimen in Berkeley's herbarium have been examined and found to agree closely in size, shape, and other characters with those of our own organism. Their position on the host is also the same. Moreover, the asci and spores in the specimen from Cooke's herbarium are indistinguishable from those of the fungus of take-all. (Text Figure 1*b*.) There is, in fact, no point of evident difference between our organism and *S. cariceti* as seen on *Aira caespitosa* in these two specimens at Kew. Since asci and spores can not be obtained from the type specimen, it is not possible by a comparison of specimens alone to demonstrate that the material in the herbarium of Cooke is unquestionably *S. cariceti.* However, it agrees completely with the rather brief original description of the species given by Berkeley and Broome.[8] Fortunately, moreover, accompanying the description, drawings of an ascus and two spores are given which agree well in size and shape with the material in the herbarium of Cooke and with our own material of the take-all fungus. The spores as drawn are non-septate, but the arrangement of the guttulae indicates that at maturity a septation corresponding to that in the Cooke material would occur.

Since the perithecium of *S. cariceti* as seen in the type specimen is characteristic and agrees completely with that of the take-all organism, there would be on this basis alone considerable justification for regarding the two as the same. When as corroborative evidence the available data concerning the asci and spores are considered the identity of the two forms does not admit of a reasonable doubt.

The perithecia of the fungus from *Iris foetidissima* labeled *S. eucrypta* B. & Br. differ in several essential respects from those

[8] Berkeley, M. J., and Broome, C. E. Notices of British Fungi. Ann. and Mag. Nat. Hist. 7: ser. 3. 455. Pl. 17, fig. 35. 1861.

of *S. cariceti*. Instead of lying beneath the outer leaf sheath as in the latter species they occur within the tissue of the sheath itself. They possess much shorter beaks, lacking any pronounced tendency toward curvature, and protrude less evidently. The spores, although of about the same length, are considerably narrower and more flexuous. The asci are also correspondingly narrower. (Text Figure 1*a*.) In fact, the fungus differs strikingly from *S. cariceti* in several respects, the spores, though different, constituting the most evident point of resemblance. Since this material is not the type collection, and since it was found on another host plant, the possibility exists that it is not in reality *S. eucrypta*. It agrees, however, with the original description[9] of this species, except in the possession of somewhat longer spores, and is probably identical with it. In the original description the spores are said to be one five-hundredth of an inch ($50\,\mu$) in length. Saccardo states erroneously that they measure $125\,\mu$. Since his description is based on that of Berkeley and Broome, this is merely an evident error in conversion of inches to microns, and has already been noted by Berlese, who gives the dimensions as $70–74 \times 3\,\mu$. Even if it were assumed that the type collection of *S. eucrypta* was in fact a different organism from that on *Iris foetidissima* there would be no justification for the assumption that it was identical with *S. cariceti*. The original descriptions of *S. eucrypta* and *S. cariceti* and the drawings which illustrate them are clearly based on two different species, and it is evident that Berlese was in error in regarding them as identical. Also it is evident that the name *Ophiobolus graminis*, widespread in the literature of the take-all disease, must be supplanted by the less familiar name, *O. cariceti* (B. & Br.) Sacc. If the examination of the type specimen of *O. graminis* shows it to be identical, as we believe, with *O. cariceti* the Saccardo name, being more recent, must be relegated to synonomy. If, on the other hand, it should prove to be specifically distinct, it will then have no significance in connection with the take-all disease.

Several other species of *Ophiobolus* have been described as occurring on the culms of grasses, but none of them resemble

[9] Berkeley, M. J., and Broome, C. E. Notices of British Fungi. Ann. and Mag. Nat. Hist. 9: ser. 2. 383. Pl. 12, fig. 40. 1852.

closely the take-all organism. Since several authors have mentioned *O. herpotrichus* in connection with the disease, it, however, must be considered. The perithecia as pictured by Berlese resemble somewhat those of *O. cariceti*, but the asci and spores are very different. The spores are twice as long as those of the take-all organism, and are flexuous, thread-like, multiseptate, and brown. Confusion of the two species, therefore, is impossible.

Since the published diagnoses of *O. cariceti* are very brief and incomplete, the following description has been prepared. It is based on the specimens of *S. cariceti* received from Kew and on several collections of American and foreign material of the fungus found associated with the take-all disease. Consideration of the appearance of the fungus in pure culture is omitted.

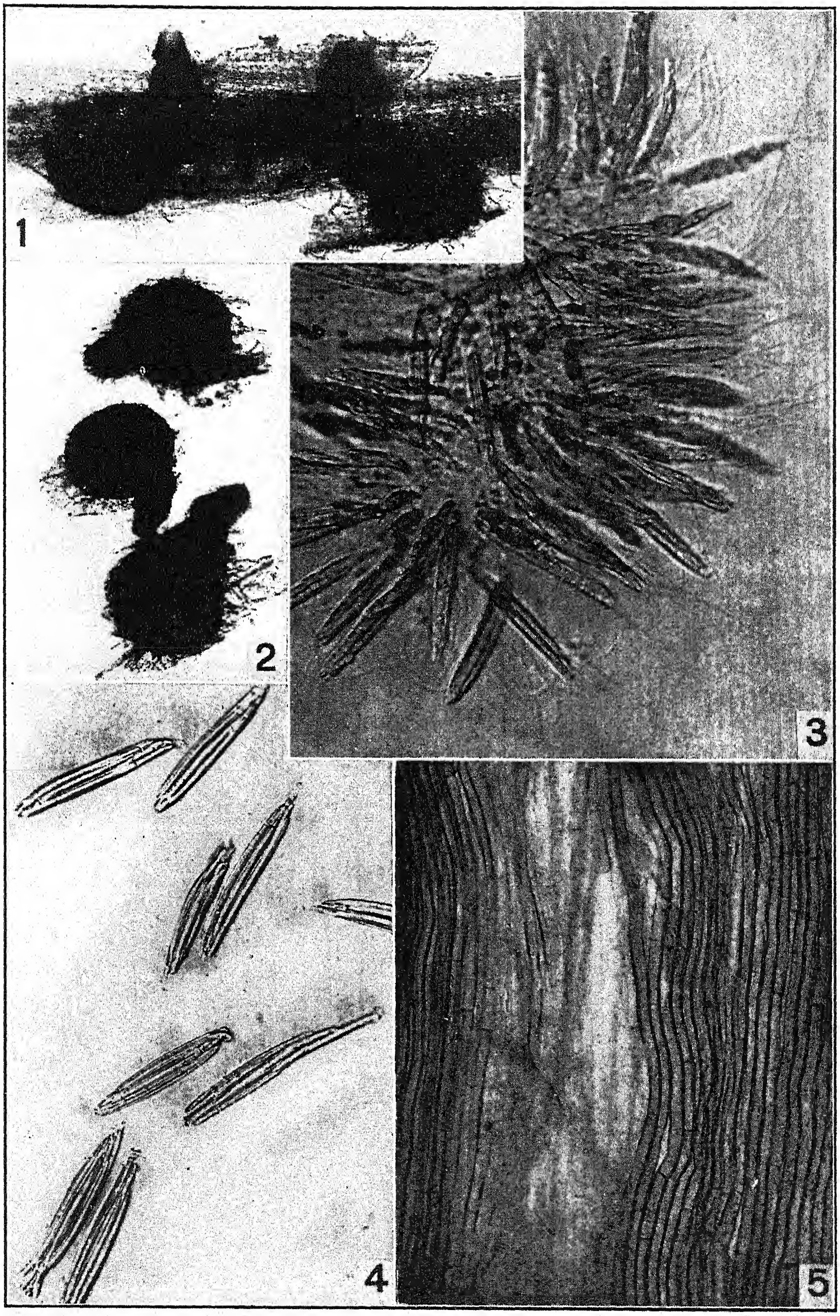
OPHIOBOLUS CARICETI (Berk. & Br.) Sacc., Sylloge Fungorum **2**: 349. 1883.

Sphaeria cariceti Berk. & Br., Ann. & Mag. Nat. Hist. **7**: ser. 3. 455. *pl. 17. fig. 35.* 1861.

? *Rhaphidophora graminis* Sacc., Nuovo. Giorn. Bot. Ital. **7**: 307. 1875.

? *Ophiobolus graminis* Sacc., Revue Mycol. **3**: No. 11. 45, 1881; and Syll. Fung. **2**: 349. 1883.

Mycelium permeating the roots of the host, causing them to become very brittle and easily broken away, developed profusely above the crown of the plant in and about the leaf sheaths, and forming a definite thick plate between the inner leaf sheath and the culm; the mycelial plate (Fig. 5) usually adhering to the culm when the leaf sheaths are stripped away, composed of coarse, dark brown hyphae, three to six microns in diameter, which frequently run rather definitely parallel to one another forming broad, flat, ribbon-like strands resembling somewhat compressed rhizomorphs; perithecia membranaceo-carbonaceous, dark brown to black, smooth, rostrate, ostiolate, occurring on the roots of the host especially within thick wefts of fine rootlets developed abnormally about the crown of the plant, but more frequently observed arising from the mycelium beneath the outer leaf sheath, standing singly or in groups, the individuals in a group occasionally fused laterally but no true stromatic tissue developed, firmly bound to the leaf sheaths by numerous strands of mycelium attached both to the neck and



OPHIOBOLUS CARICETI (BERK. & BR.) SACC.

ascigerous portion, often developed in great numbers, more than one hundred individuals having been counted on a single culm, when young hidden from view but at maturity the beaks protruding and prominent, and by the shredding of the leaf sheath the upper hemisphere of the perithecium often exposed to view; perithecial beak developed obliquely and in the beginning lying more or less parallel to the surface of the culm, later, curving sharply outward, penetrating the leaf sheath and protruding, the obliquely attached curved beak so characteristic of the species as to be almost diagnostic (Fig. 1); ascigerous portion of the perithecium globose or subglobose, though sometimes compressed between the leaf sheaths, 330–500 μ (usually about 425 μ) in diameter, narrowing gradually into the truncate-conoid to cylindrical beak which frequently attains a length as great as the diameter of the ascigerous cavity (Fig. 2); asci (Fig. 4 and Text Fig. 1*b*) numerous, fascicled, elongate-clavate, straight or curved, short stipitate to subsessile, 90–115 x 10–13 μ, rounded at the apex, 8-spored, thin-walled; paraphyses (Fig. 3) abundant, thread-like, flexuous, unbranched, hyaline; ascospores fascicled to sub-biseriate, hyaline, as viewed together in the ascus faintly yellowish, linear, curved, broader at the middle and tapering gradually toward the ends, the upper end rounded, the basal end more acute and sometimes more sharply curved, 60–90 (chiefly 70–80) x 3 μ, when young continuous and multiguttulate, at maturity 5–7-septate, not reaching morphological maturity until late autumn or winter.

Parasitic on wheat, barley, rye, and various wild grasses, causing the take-all disease, apparently cosmopolitan in its distribution.

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EXPLANATION OF PLATE 10

Ophiobolus cariceti

All the figures were made from American material collected on wheat plants showing the typical symptoms of the take-all disease.

Fig. 1. Two perithecia developed below the outer leaf sheath. The oblique beaks illustrate one of the most characteristic features of the species. × 35.

Fig. 2. Three perithecia illustrating variation in shape. They are shown as they appear in a microscopic mount after removal from the plant, and no attempt was made to orient them in the erect position. × 35.

Fig. 3. A fascicle of asci and paraphyses. × 240.

Fig. 4. Asci. × 300.

Fig. 5. A portion of the mycelial plate formed about the culm. × 300.

A PRELIMINARY LIST OF THE MYXOMYCETES OF THE CAYUGA LAKE BASIN

F. B. Wann and W. C. Muenscher

During the last five years the writers have made numerous collections of Myxomycetes in central New York, especially in the vicinity of Cornell University and Ithaca. These collections and many others which have been contributed by a number of collectors, as well as those available in the local herbaria, have been critically studied. In all, approximately 800 collections have been examined. The preliminary list given below is a record of all the species of Myxomycetes which the writers have seen and which are represented by material collected within the Cayuga Lake Basin.

The region covered by this list includes the territory drained by Cayuga Lake, the central lake of the Finger Lakes system of central New York. Roughly, the area includes a narrow strip averaging about eighteen miles in breadth, extending from Montezuma on the Erie Canal southward about sixty-five miles to Summit marsh in the northern part of Tioga County. The region includes the environs of Cornell University and the McLean Wild Life Preserve.

The list includes 92 species, in 30 genera and 11 families. Varieties are not recorded individually. Lister[1] gives 49 genera in 13 families for the world. The local representation of Myxomycetes would at first sight seem to be unusually large, but a more careful search will doubtless reveal many species in other localities with similar climatic conditions. The nomenclature used and the arrangement of species and genera under families adopted is essentially that used by Lister.[1]

The writers wish to acknowledge their indebtedness to the many persons who have contributed specimens to them from time to time; to Prof. H. H. Whetzel, who first suggested the work, for his constant interest and the many specimens contributed to us; to Prof. H. M. Fitzpatrick, for placing at our disposal for examina-

[1] Lister, A. A Monograph of the Mycetozoa. Ed. 2. 1911.

tion the Myxomycetes in the herbarium of the Department of Plant Pathology, New York State College of Agriculture, and also those in his private herbarium; to Prof. W. W. Rowlee, for giving us access to the collections in the herbarium of the Department of Botany of Cornell University; to Miss G. Lister, for verifying a number of doubtful specimens in the more difficult genera; and to Prof. T. H. Macbride, for his opinion regarding several collections.

The writers present this preliminary list, though incomplete, with the hope that it will stimulate interest in the discovery of other species which have not yet been seen from this locality.

MYXOMYCETES OF THE CAYUGA LAKE BASIN

SUBCLASS I.—EXOSPOREAE

Family 1. Ceratiomyxaceae

Ceratiomyxa fruticulosa (Muell.) Macbr.
Ceratiomyxa porioides (Alb. and Schw.) Schroet.

SUBCLASS II.—ENDOSPOREAE

Family 2. Physaraceae

Badhamia macrocarpa (Ces.) Rost.
Badhamia rubiginosa (Chev.) Rost.
Badhamia utricularis (Bull.) Berk.
Craterium leucocephalum (Pers.) Ditm.
Craterium aureum (Schum.) Rost.
Diachaea leucopoda (Bull.) Rost.
Diachaea splendens Peck
Diderma effusum (Schw.) Morgan
Diderma globosum Pers.
Diderma spumarioides Fries
Diderma testaceum (Schrad.) Pers.
Fuligo septica (L.) Gmelin
Leocarpus fragilis (Dickson) Rost.
Physarum cinereum (Batsch) Pers.
Physarum citrinellum Peck
Physarum citrinum Schum.
Physarum compactum (Wing.) Lister
Physarum contextum Pers.
Physarum flavicomum Berk.
Physarum galbeum Wing.
Physarum globuliferum (Bull.) Pers.
Physarum leucopus Link
Physarum melleum (Berk. and Br.) Massee

Physarum nucleatum Rex
Physarum nutans Pers.
Physarum polycephalum Schw.
Physarum pulcherrimum Berk. and Rav.
Physarum pulcripes Peck
Physarum rubiginosum Fries
Physarum sinuosum (Bull.) Weinm.
Physarum tenerum Rex
Physarum virescens Ditm.
Physarum viride (Bull.) Pers.

Family 3. Didymiaceae
Didymium clavus (Alb. and Schw.) Rost.
Didymium crustaceum Fries
Didymium difforme (Pers.) Duby
Didymium melanospermum (Pers.) Macbr.
Didymium squamulosum (Alb. and Schw.) Fries
Lepidoderma tigrinum (Schrad.) Rost.
Mucilago spongiosa (Leyss.) Morgan

Family 4. Stemonitaceae
Comatricha irregularis Rex
Comatricha longa Peck
Comatricha nigra (Pers.) Schroet.
Comatricha pulchella (Bab.) Rost.
Comatricha typhoides (Bull.) Rost.
Enerthenema papillatum (Pers.) Rost.
Lamproderma arcyrionema Rost.
Lamproderma columbinum (Pers.) Rost.
Lamproderma scintillans (Berk. and Br.) Morgan
Lamproderma violaceum (Fries) Rost.
Stemonitis ferruginea Ehrenb.
Stemonitis fusca Roth.
Stemonitis herbatica Peck
Stemonitis hyperopta Meylan
Stemonitis splendens Rost.

Family 5. Amaurochaetaceae
Brefeldia maxima (Fries) Rost.
Amaurochaete fuliginosa (Sow.) Macbr.

Family 6. Heterodermaceae
Cribraria argillacea Pers.
Cribraria aurantiaca Schrad.
Cribraria intricata Schrad.
Cribraria macrocarpa Schrad.
Cribraria purpurea Schrad.
Dictydium cancellatum (Batsch) Macbr.
Lindbladia effusa (Ehrenb.) Rost.

Family 7. Tubulinaceae
Tubifera ferruginosa (Batsch) Gmelin

Family 8. Reticulariaceae

Dictydiaethalium plumbeum (Schum.) Rost.
Enteridium Rozeanum (Rost.) Wing.
Reticularia Lycoperdon Bull.

Family 9. Lycogalaceae

Lycogala epidendrum (Buxb.) Fries
Lycogala flavofuscum (Ehrenb.) Rost.

Family 10. Trichiaceae

Hemitrichia clavata (Pers.) Rost.
Hemitrichia serpula (Scop.) Rost.
Hemitrichia vesparium (Batsch) Macbr.
Oligonema flavidum (Peck) Massee
Trichia Botrytis Pers.
Trichia decipiens (Pers.) Macbr.
Trichia favoginea (Batsch) Pers.
Trichia persimilis Karst.
Trichia scabra Rost.
Trichia varia (Pers.) Rost.

Family 11. Arcyriaceae

Arcyria cinerea (Bull.) Pers.
Arcyria denudata (L.) Scheldon
Arcyria ferruginea Sauter
Arcyria globosa Schw.
Arcyria incarnata Pers.
Arcyria nutans (Bull.) Grev.
Arcyria Oerstedtii Rost.
Perichaena chrysosperma (Currey) Lister
Perichaena corticalis (Batsch) Rost.
Perichaena vermicularis (Schw.) Rost.

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NOTES AND BRIEF ARTICLES

[*Unsigned notes are by the editor*]

Dr. W. A. Murrill lectured on "Edible Wild Mushrooms" before the International Garden Club on the afternoon of Thursday, November 3.

Dr. L. O. Overholts, of the Pennsylvania State College, spent the latter half of December at the Garden, completing his study of *Pholiota,* an important genus of the fleshy fungi, for early publication in *North American Flora.*

Mrs. Alexander Taylor has presented to the Garden a number of colored drawings of fleshy fungi which she made in New Jersey, Massachusetts, and elsewhere. Dried specimens accompany the drawings.

Fungi detrimental to drugs—chiefly mildews, smuts, and rusts—are treated by Emil Herrmann in Pharm. Zentralh. **61**: 95–100. 1920.

Red or purple rice owes its color to a mold, *Monascus purpureus.* See an article on the manufacture of Chinese Ang Khak in the United States by Margaret Church in Jour. Indus. Eng. Chem. **12**: 45, 46. 1920.

A mosaic disease of Chinese cabbage, mustard, and turnip, which may be transmitted by aphids or by direct transfer of juice, was described and handsomely figured by E. S. Schultz in the *Journal of Agricultural Research* for October 15, 1921.

The stipitate polypores of Brazil have been described, figured, and keyed by C. Torrend in *Broteria* (Ser. Bot. **18**: 121–143. *pl. 5–8.* 1920). In the genus *Amauroderma* alone 34 species are

included, 3 of which—*A. Gusmanianum*, *A. picipes*, and *A. Mosselmanii*—are proposed as new.

Inonotus perplexus was found at Yama Farms, October 25, 1921, on a small dead trunk of *Populus grandidentata*. The cluster of overlapping pilei extended for ten inches or more up and down the trunk about a yard above the ground.

Professor F. S. Earle has returned to Porto Rico and is located at Central Aguirre, which is on the dry side of the island and not very good for fungi. He still finds a few specimens, however, which he shares with the Garden. Mrs. Earle is with him.

Professor A. F. Hutchinson, of the University of British Columbia, located at Vancouver, has sent for determination a box of woody fungi from his region. Among them is a handsome specimen of *Ganoderma oregonense*, collected on a dead stump of *Pseudotsuga taxifolia*.

Dr. H. H. Whetzel, who is this year acting as first agricultural assistant in the Department of Agriculture, Bermuda, has sent to the Garden herbarium his first collections of fungi from that region. Dr. Whetzel will have an unusual opportunity for working up the fungi of Bermuda.

The sclerotia-forming polypores of Australia are described and figured by Cleland and others in Trans. Proc. Roy. Soc. S. Austr. **43**: 11–22. *pl. 1–5.* 1919. True sclerotia are said to be caused by *Polyporus mylittae* and *P. minor-mylittae*, and false sclerotia by *P. tumulosus* and *P. basilapiloides*.

Several large and handsome photographs of fleshy fungi have recently been presented to the Garden by Mr. A. W. Dreyfoos, of Mount Vernon, New York, who has been interested in the fungi for several years. Among them are group pictures taken in the field of *Chanterel floccosus*, *Clitocybe illudens*, and *Lepiota procera*.

According to Barlot (Compt. Rend. **171**: 1014–1016. 1920), a 20–40 per cent aqueous solution of potash will distinguish *Mycena pura* from *Laccaria laccata,* the former giving a yellow and the latter a dark-brown color. *Gomphidius viscidus,* when similarly treated, gives a violet-brown color, while *G. glutinosus* yields a pale-yellowish brown.

Inonotus dryophilus was again fruiting on the white oak near the waterfall in the hemlock grove late in October, 1921. This time there were two clusters of hymenophores almost touching each other about two feet above the ground on the south side of the tree. These clusters were each about five inches broad and high, and projected about three inches from the trunk.

Canvas-destroying fungi were discussed by J. Ramsbottom in *Nature* (**105**: 563, 564. 1920), with various methods of inhibiting their development and growth. Species of *Macrosporium* and *Stemphylium* appeared to be the chief destructive agents, Soap, followed by alum and copper sulfate, gave good results at Malta; while sodium chromate proved superior in Saloniki.

Dr. Whetzel has sent in a number of fungi from Bermuda, among them *Laetiporus sulphureus, Lepiota cretacea, Auricularia nigrescens, Coriolus sericeohirsutus, Simblum sphaerocephalum, Polyporus Bracei, Hydrocybe ceracea,* and *Hydrocybe Earlei.* The last is a very beautiful species described and previously known only from Herradura, Cuba, where it grew in a pasture. According to Prof. Earle, the original collector, the colors become more brilliant after drying.

Coprinus micaceus was abundant in the horticultural grounds of the Garden on December 1. This was due to warm weather and late fall rains following a period of dry weather. About the middle of December several species of fleshy fungi were found growing in the woods at Blacksburg, Bedford, and other localities in Virginia. *Pleurotus ostreatus* and *Collybia velutipes* were abundant and rather to be expected, but species of *Cortinarius*—

like *C. semisanguineus*—and of *Russula*—like *R. emetica*—were also seen.

An unusually large cluster of the velvet-stemmed Collybia, *Gymnopus velutipes,* was observed November 20 on a decaying willow leaning over the Bronx River in North Meadows. This attractive edible species, which persists throughout the winter, was quite common during the autumn on various kinds of dead wood, but it seems to be partial to willow. The cluster in question measured six by eight inches and contained nearly a hundred distinct mushrooms—enough for a considerable meal. It has been suggested by Stewart that this species might easily be cultivated for food.

A large specimen of *Roskovites granulatus,* measuring over three inches in breadth, was found recently under white pine trees east of Conservatory Range 1. This rather common, edible species of *Boletus* grows naturally under pines and other evergreens and seems to be following *Boletus luteus* in its method of introduction into our grounds. The two species are much alike, but *B. luteus* has an ample white ring, is much more slimy, and the surface is usually darker. It will be remembered that this species, *B. luteus,* which is also edible, appeared several years ago under the pines near Conservatory Range 1 and has since spread about the base of individual trees, especially on the northern side, until basketfuls of it may be collected after the autumn rains.

While doing agricultural extension work in Franklin County, Washington, the writer found a fungus that was unknown to him. Upon returning to the State College the fungus was determined as a species of *Battarrea.* Further study has shown that the fungus coincides closely with *Battarrea laciniata* Underwood. This specimen was collected by the writer June 25, 1921, three miles west of Pasco, Franklin County, Washington. It was growing under a large sage brush, *Artemisia tridentata,* in pure silica sand near the banks of the Columbia River. For a description of this species, see Miss White's article on the "Tylostomaceae of North Amer-

ica," published in Torrey Bulletin 8: 421–444. 1901.—*G. L. Zundel.*

In Dr. Robert T. Morris's handy and excellent little book on "Nut Growing," published last autumn by the Macmillan Company, the chief fungous parasites of nut trees are treated together on pp. 153–158, and later under each tree separately. *Melanconium oblongum,* according to Dr. Morris, is gradually killing our native butternut and is also attacking the imported Japanese walnut. The hazel blight, *Cryptosporella anomala,* makes little headway among our native hazels, which are accustomed to it, but violently attacks the Asiatic and European species when they are imported. The bacterial walnut blight and chestnut blight are also considered, together with methods of combating both the fungous and insect pests of nut trees.

In a note in *Mycologia* **13**: 58 the question was raised as to whether the cause of the difference between *Pucciniastrum* as it occurs on *Rubus triflorus* (*R. pubescens*) and on *R. idaeus aculeatissimus* (*R. strigosus*) lay in the parasites or in the hosts. In the summer of 1921, Mr. C. W. Bennett, working in the department of plant pathology of the University of Wisconsin, found that uredospores from *Rubus triflorus* did not infect *R. strigosus* or *R. occidentalis,* while those from *R. strigosus* infected that host abundantly and *R. occidentalis* sparingly, and on very young leaves only. As far as these few experiments go, they indicate that *Pucciniastrum arcticum* (Lagh.) Tranz. and *P. americanum* (Farl.) Arth. are distinct, and suggest that *Rubus strigosus* and *R. occidentalis* are not equivalent hosts of the latter.—*J. J. Davis.*

A FRAGRANT POLYPORE

Trametes suaveolens is a large white polypore frequent on decaying willow trunks in the northern hemisphere and easily dis-

tinguished, even at some distance, by its very agreeable, anise-like odor. In all my collecting, both in America and Europe, I never found this species on anything except willow until October 18, 1921, at Yama Farms, when I observed two large, fresh hymenophores about eight inches wide growing on a fallen dead trunk of the large-toothed aspen, *Populus grandidentata,* in the woods above the power-house west of Napanoch. The nearest willows were specimens of *Salix alba* in the Japanese garden of Yama Farms about a quarter of a mile away, and several hymenophores of *T. suaveolens* were conspicuous on their trunks. After this experience, I looked through our herbarium and found two other specimens collected on poplar, one by C. C. Hanmer (*2058*) at Hartford, Connecticut, many years ago, and the other by P. Wilson at Glenerie Falls, New York, August 31, 1914. The latter was at the base of living *Populus grandidentata* not very far from where I found my specimen. Mr. Hanmer did not mention the species of poplar on which his specimen grew. Poplars are near relatives of the willows, which accounts for their ability to serve as occasional hosts for this fungus.

W. A. MURRILL

SCHIZOPHYLLUM COMMUNE WITH A STIPE

Dr. C. E. Fairman's recent article, "The Fungi of Our Common Nuts and Pits,"[1] brings to mind the occurrence, some years back, of *Schizophyllum commune* on chestnuts imported from the Orient. The chestnuts had been placed in wet sand, in germinating trays, in the greenhouse of the United States Plant Introduction Field Station, at Chico, California. Buried to the depth of about two inches, they remained thus for a period long enough to induce germination, but, instead of young chestnut seedlings, a crop of the *Schizophyllum* appeared, much to the astonishment—and amusement—of the gardener, Mr. Henry Klopfer. On exhuming the nuts, it was found that nearly all had produced from their shells (not from their kernels) beautiful specimens of this common fungus, each specimen supported on a distinct stem that

[1] Proc. Rochester Acad. Sci. 6: 73–115. *pl. 15–20.* Sept. 1921.

was just long enough to permit of the formation of the sporophore in the light.

As *Schizophyllum commune* (*S. alneum* of some authors) is normally astipitate, this case of adaptation to conditions is worthy of notice, and the name, form *stipitatum*, might be conveniently employed to designate such deviations from the type. The specimens were not kept, unfortunately.

While the writer was located at Chico he also noted that this species, in its normal state, is not infrequent on wounds in the bark of orange trees.

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LOUIS C. C. KRIEGER

HYGROPHORUS CAPRINUS

A fine cluster of this species was sent to me last October by Miss Eliza B. Blackford, who collected it in low, swampy places in coniferous woods at Ellis, Massachusetts, where she has noticed it for ten years or more during October and early November.

The original description by Scopoli (Fl. Carn., ed. 2. **2**: 438. 1772) is brief, but quite suggestive: " Pileus planiusculus. Lamellae amplae, continuae, simplices et ramosae. Stipes filamentosus. Habitat in subsylvestribus herbidisque locis. Pileus laevis; trium unciarum diametro, a Capris avide quaesitus. Stipes digiti humani crassitie, plenus, nudus, solitarius, basi tenuior." The specific name was selected because goats were so fond of it.

A more detailed description was published by Albertini and Schweinitz in 1805 (Consp. Fung., p. 177) under their *Agaricus camarophyllus fuligineus*. Their variety *atramentosus* is quite different from our plant, the pileus being atrocoeruleous in color.

Krombholz gives a fair representation of the American form under *Agaricus elixus* Sow. in his plate 72, figure 22, but the other two figures are different. *Hygrophorus fuligineus* Frost is dark-colored and the gills are white, but the entire hymenophore is heavily covered with slime.

Fries transferred this species to *Hygrophorus* in 1838 and Karsten placed it in *Camarophyllus* in 1879, using Scopoli's origi-

nal specific name in combination. The only other specimen I seem to have is one collected by Bresadola in fir woods near Trent in October, 1897. The following notes were made from the fresh specimens sent by Miss Blackford:

Dry when received but evidently slightly sticky when moist, virgate with delicate fibrils, uniformly avellaneous or slightly darker, top-shaped when young, slightly umbonate at times, cespitose, 6–7 cm. broad; context thick, pure-white, unchanging, taste sweet, nutty, odor becoming mealy in drying; lamellae short-decurrent, distant, very broad in front, tapering behind, mostly simple, white or slightly dirty-white, never yellowish, entire on the edges; stipe slightly tapering downward, subglabrous, white or slightly avellaneous, fistulose to stuffed, 6 cm. long, 1 cm. or more thick above; veil none.

W. A. MURRILL

AN ADDITION TO THE DISTRIBUTION OF A RARE FUNGUS

Early in the morning, October 23, 1921, I started with some of my first-year students on a walk to Hueston's Wood, five miles north of Oxford, Ohio. We reached the wood at daylight, and within a half hour Miss Grace Townsend, a keen-eyed freshman, spied something rising from the soil which brought forth a burst of enthusiasm. On reaching the spot, I decided at once that she had discovered something which had escaped notice hitherto, though I have botanized through this 200-acre stretch of beech wood with my students for fifteen years, on five different occasions remaining in camp for ten or twelve days and botanizing vigorously every day. The globose peridium, a centimeter and a half in diameter, expanded abruptly from the top of a somewhat slender stipe, which was five centimeters high and a half centimeter in diameter. The outer wall of the peridium was free from the stipe in a manner wholly unknown to me, while from the top of this peridium there arose a peculiar little chimney-like ostiole, which was a millimeter high and a little more than a millimeter in diameter. The peridium was a pale brownish, and the stipe was darker with a reddish cast. In short, the whole appearance was such as to excite the curiosity of an experienced mycologist, accustomed

to finding curious fungi. Diligent search netted us three specimens in all.

On reaching home, I consulted C. G. Lloyd's mycological notes, and soon discovered that the curious fungus belonged to the genus *Tylostoma* or *Tulostoma,* the first spelling preferable and the second perhaps the original. I sent one of the plants to Mr. Lloyd for specific determination, supposing that the three plants belonged to one of the common species of the genus. Mr. Lloyd's reply was as follows: "Your *Tylostoma* is *Tylostoma verrucosum* as named by Morgan. It is a very rare species, and I have collected it but once. It has a regular, tubular mouth, where it differs from *Tylostoma campestre.*"

Mr. Lloyd's monograph of the "TYLOSTOMEAE" appeared in 1906, at which time this rare species was known through but three collections, the original one by A. P. Morgan, near Preston, Ohio, the second by Mr. Lloyd himself, also in Ohio, and the third by W. H. Long, in Texas. There is nothing in Mr. Lloyd's letter to indicate that other collections have been made outside the original area, and ours seems to be the fourth locality from which this rare and interesting fungus has been collected.

Our three plants are very nearly of the same size, and the stipes are somewhat longer and the peridia somewhat smaller than Mr. Lloyd's Fig. 4, in plate 76 of his monograph.

BRUCE FINK

THE TORONTO MEETING

The thirteenth annual meeting of the American Phytopathological Society was held at Toronto, Canada, December 27–31, 1921. Prof. J. H. Faull, of the University of Toronto, had charge of the phytopathological exhibits. Section G of the A. A. A. S. and the Mycological Section of the Botanical Society of America assisted as usual with the program where the subjects and discussions were of mutual interest. Dr. Howe and Dr. Harper represented the New York Botanical Garden. Of the 2,000 present at the general meeting, about 200 were botanists. The next president of the Botanical Society of America is H. C. Cowles. The new

officers of the Phytopathological Society are: E. C. Stakman, president; N. J. Giddings, vice-president; Perley Spaulding, editor-in-chief, with L. L. Harter and G. M. Reed, assistants. The meeting next year will be held in Boston.

The most popular address was probably that by Prof. Bateson on "Evolutionary Faith and Modern Doubt." The symposium on the "Utility of the Species Concept" was important and well-timed. Dr. Millspaugh was unfortunately kept away by illness. Mosaic diseases occupied a prominent place at the meeting, about 20 papers being presented dealing with this subject. Dr. Duggar experimented with the mosaic disease of tobacco and found that the "virus" filters through porous cups as a liquid and therefore can not be a germ or similar organism. He termed it a "living fluid contagion." Experiments by Johnson, who has long worked on tobacco mosaic, led him to make the following statement: "It seems, therefore, that these results furnish evidence against the enzymatic theory of mosaic, while at the same time they favor parasitic hypothesis, since the temperature curve for the development of mosaic corresponds closely with that of the development of many of the plant pathogens."

Freda Detmers discussed the parasitic effect of *Poronidulus conchifer* on elm branches, claiming that it seems to be more injurious at times than suspected. L. M. Massey discussed "Fusarium-rot" of the Gladiolus. The corms become infected in the field and the rot advances in storage. The fungus seems to be *Fusarium oxysporum* Schecht. A poplar canker, caused by *Hypoxylon pruinatum,* was described by Povah. This disease is a trunk canker, which blackens the sapwood. It is very serious in certain sections. W. H. Snell spoke of the effect of heat upon the mycelium of certain structural timber-destroying fungi within wood, concluding that heating structures affected with decay to 47–48° C. by means of the heating systems, as has been suggested, would not kill the fungi even in moist cotton weave sheds, although the drying effect would be beneficial in certain types of structures. The application of these results to the effect of kiln drying upon structural timber decay was pointed out. R. J. Blair spoke of experiments with storing wood pulp in water to protect it from

fungi. An experiment was carried out using several kinds of commercial pulps in order to test the preservative value of water upon sheets of pulp immersed in it. After an interval of seventeen months the pulp was examined and tested for freeness. It was then made into small sheets of paper, which were tested for bursting strength and for tensile tear. The pulp stored in water came through the test in much better condition than that which was piled on a shed where it was given an opportunity to dry out.

W. A. MURRILL

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MYCOLOGIA

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A NEW SEPTOBASIDIUM ON PINUS STROBUS *

WALTER H. SNELL

(WITH PLATES 11–13)

The writer is indebted for the opportunity to present this article to the kindness of Dr. E. A. Burt. Two years ago specimens of a species which appeared to be a *Septobasidium,* commonly found upon the bark of the eastern white pine, were sent to Dr. Burt for identification. In reply he stated that this fungus had never been found sporulating and suggested that an effort be made to find it in a fertile condition. The writer immediately began collecting the fructifications from different localities in New England, and later extended the field of observations to Wisconsin. Collections were made throughout that summer and fall into November and beginning again early the next spring. In the summer of 1920 at North Conway, N. H., August was ushered in with moist or rainy weather which lasted through the middle of the month. A collection made after about two weeks of this sort of weather showed that the probasidia had germinated and sporulation was taking place in abundance. The material was sent to Dr. Burt and he very magnanimously returned it to the writer for study and description. The name given to the fungus is *Septobasidium pinicola.*

This species of *Septobasidium* is a northern form growing at least as far north as northern New Hampshire, whereas most of the species of the genus are tropical or subtropical. *Septobasidium*

* Office of Investigations in Forest Pathology, Bureau of Plant Industry, in coöperation with Department of Botany, Brown University.

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pseudopedicillatum is the only other species which appears in the temperate zone in the United States. The known geographical range of *S. pinicola* is thus far rather puzzling. The writer knows of its occurrence in all the New England states but Rhode Island and in New York, but no collections in Canada or the middle western white pine states are known. The writer is quite sure that he has collected it in Wisconsin, but the collection can not be found, nor can collections by others in Michigan, Wisconsin, or Minnesota be located. On the other hand, Dr. Weir, of this office, informs the writer that this same *Septobasidium* occurs also upon *Pinus monticola* in the western states and cites one of his collections from Idaho. No further data are at hand, however, relative to its distribution west of the Mississippi or of the possibility of its occurrence upon *Pinus lambertiana*. It is very likely to be found abundantly in certain loci in pine woods in the east, and occasionally dozens of the fruit bodies may be seen upon a single tree. They have been found only very rarely on trees under 3 inches in diameter at the base, but have been collected, however, on very small twigs of larger trees.

The fruit bodies of *S. pinicola* occur only upon the smooth bark of white pines. They are especially common in the angles made by the lower sides of the branches with the trunk (Plate 11). As far as the tree is concerned, the fungus is a pure epiphyte. It lives entirely superficially, and not only does not injure any living tissue, but does not even penetrate the outer bark (Plate 13, fig. 1). It is not associated with wounds, pitch flow, blister rust cankers, or any other fungus, although it is often overgrown with a lichen, especially when old. The fruit bodies do not bear any decided relation to the points of the compass. In some spots in the woods it has appeared that there were more fructifications upon the northeast half of the trunk than upon the southwest half, but this is by no means universally true. The sporophores are found more commonly on well-shaded portions of the trees, but they are occasionally found where they are exposed to the direct rays of the sun.

Other species of the genus *Septobasidium* are known to be associated with scale insects (1, pp. 321–322; 2; 3), and the status of *S. pinicola* in this respect is at once brought in question. An

entomogenous relation is suggested not only by this fact, but also by its manner of growth and the common occurrence of a scale insect upon the pine. Cursory observations show that such a relation exists. If a fruit body is carefully separated from the pine bark, the remains of the scale insects can readily be seen on the lower surface or on the pine bark, either as brown skeletons or cases, or white-lined pockets in which the insects were inclosed (Plate 12, fig. 1). If small fruit bodies 2–3 mm. large are examined, the white bodies of the insects are easily made out imbedded in the hyphae, and examination of these under the microscope leaves no doubt as to their identity or their relation of the fungus to them. The insects are overgrown and intergrown with mycelium of the fungus, which can be determined to be within their bodies (Plate 12, fig. 2). The hyphae in the youngest insects were hyaline (see fig. 2) and on the older ones were dark like that of the context.

The fructifications are more or less ashy colored and are conspicuous against the greenish bark of the pine. In structure *S. pinicola* differs from most of the species of *Septobasidium* described, inasmuch as the plainly 3-layered condition discernible in most of them is not present (Plate 13, fig. 1). There is more or less of a matting of the dark hyphae close to the substrate, but it is irregular and lacunar much as is the substance above it. The remainder of the context is made up of loosely intertwined hyphae running obliquely upward, leaving empty locules and giving the whole a spongy appearance. The hymenium is formed by branching of these hyphae which form the hyaline probasidia, being thus lighter in color than the rest of the structure. The subglobose to pyriform probasidia, both at and below the surface, germinate to form straight, hyaline, three-celled spore-bearing organs. Stages in the germination of the probasidia are shown in plate 13, figure 2. The spores are born singly from each of the three cells, and, as far as could be determined, in succession and acropetally. Figure 3 of plate 13 shows this very well. This is in line with Burt's observations with the other species (1, pp. 319–20).

Septobasidium pinicola sp. nov.

Fructification resupinate, effused, coriaceous, in general circular in shape, more or less concentrically sulcate, separable from substratum, roughly tomentose to strigose, army brown to natal-brown when dry, the margin light-drab to cinnamon-drab, strigose; in structure lacunar, spongy, 1–1.8 mm. thick, individual hyphae under the microscope clay-color to tawny-olive, thick-walled, even, 3–3.5 μ in diameter, loosely interwoven so as to form a spongy structure with locules, branching to form a lighter colored hymenium about 80–110 μ thick; probasidia terminal or lateral, hyaline, pyriform to subglobose, 10–15 x 15–17 μ, throughout hymenium; spore-bearing organs straight, hyaline, 54–66 x 6–7 μ, 3-septate, growing from probasidia and projecting above hymenium; spores hyaline, simple, curved, 14–17.5 x 3–3.5 μ, borne singly from each of 3 cells of probasidium, acropetally as far as observed.

Fructification 3–60 mm. but more commonly 10–35 mm. in diameter, 1–1.8 mm. thick.

Type in herbarium of Walter H. Snell, *No. 559;* co-types in herbaria of Missouri Botanical Garden, *No. 57093,* and Forest Pathology, *No. 36832.*

On bark of living *Pinus strobus* in New England and New York and probably co-extensive with the habitat of this host; also on *Pinus monticola* in Idaho. Found sporulating after prolonged moist and rainy period in August.

Collections known:

On *Pinus strobus.*

Maine:

[1] Standish: in F. P. *No. 20639,* coll. by W. H. Chadbourne; same in Mo. Bot. Gard. comm. by Dr. Perley Spaulding.

Kennebunkport: in Mo. Bot. Gard. *No. 5091* and in Farlow Herb., coll. by Mrs. A. M. Pier, March and April.

[1] Mount Vernon: in Mo. Bot. Gard., coll. by Dr. W. J. Morse, comm. by Dr. Perley Spaulding, March.

Kittery Point: in Farlow Herb., coll. by R. T. Baxter, spring.

Brunswick: in Herb. WHS *No. 499,* June.

New Hampshire:

North Conway: in Herb. WHS *No. 559* and *No. 601;* F. P. *No. 36832,* Aug. and Sept.; several coll. in Mo. Bot. Gard., comm. by the writer and one by Dr. A. S. Rhoads, Sept.

Welch's Island, Lake Winnipesaukee: WHS *No. 502,* June.

Vermont:

Townshend: in Mo. Bot. Gard. *No. 55603* and in Farlow Herb., coll. by W. G. Hastings, comm. by Dr. Perley Spaulding.

[1] Specimens not examined by the writer.

Massachusetts:

Middleboro: WHS *No. 597*, August.

Wareham: WHS *No. 598*, August.

New York:

Lewis: WHS *No. 604*, coll. by Dr. L. H. Pennington, August.

On *Pinus monticola.*

Idaho:

St. Joe National Forest: coll. by Dr. J. R. Weir.

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EXPLANATION OF PLATES

PLATE 11

Septobasidium pinicola on bark of living *Pinus strobus.* Two fructifications are shown at the union of the branches with the trunk, where they often occur. Two-thirds natural size. Photograph by the author.

PLATE 12

Fig. 1. Lower surface of a young fructification of *Septobasidium pinicola,* showing remains of scale insects. The two groups of large bodies at the upper and lower right-hand corners of the fruit body are large ovoid or spheroid chitinous shells, dark-brown in color. The other crater-like depressions, mostly in the left half of the fruit-body, are white waxy cases enclosing scale insects such as is shown in fig. 2, which was removed from the hollow marked by the large dark spot in the center. × 10.

Fig. 2. Scale insect removed from lower surface of fruit-body shown above, showing hyaline mycelium within the body of the insect. × 143.

Photomicrographs by the author.

PLATE 13

Fig. 1. Discontinuous cross-section of portion of fruit-body of *Septobasidium pinicola,* showing relation to host tissue.

Fig. 2. Paraphysis-like organs (young probasidia ?) in hymenium.

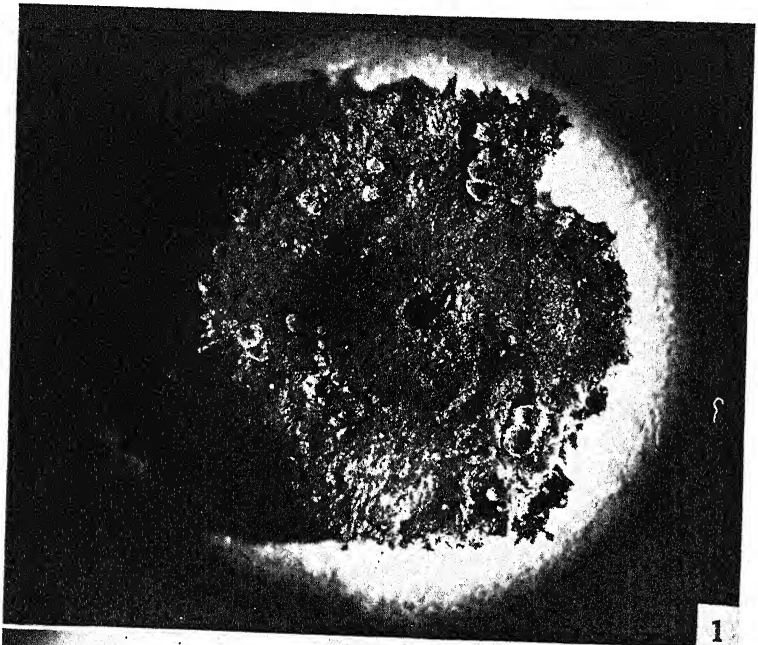
Fig. 3. Probasidia, one of them dark-colored and thicker-walled.

Fig. 4. Germinating probasidia showing stages in the formation of spore-bearing organs.

Fig. 5. Spore-bearing organs, arising from probasidia, one showing successive acropetal formation of spores. The spore on the lower sterigma is not yet quite ripe, the second sterigma has just formed, and the apical one is forming.

Fig. 6. Spores.

Fig. 7. Chlamydospore-like bodies found in the hymenium. Whether or not these belonged to this fungus or to some invading mold could not be determined.



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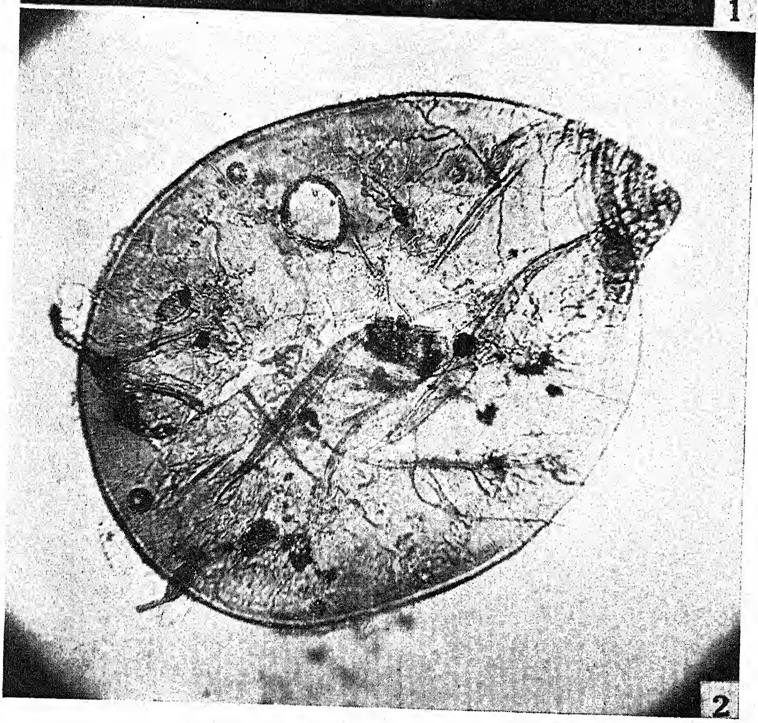
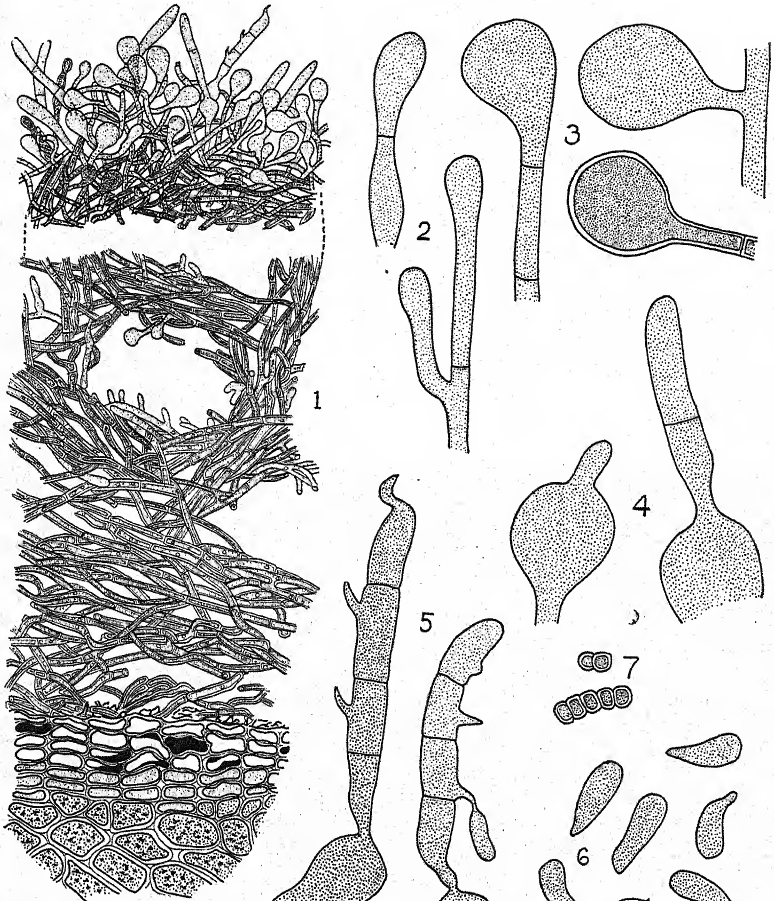


2

Septobasidium pinicola Snell

Septobasidium pinicola Snell



SEPTOBASIDIUM PINICOLA SNELL

DARK-SPORED AGARICS—I

DROSOPHILA, HYPHOLOMA, AND PILOSACE

William A. Murrill

In Mycologia for January and March, 1918, a series of eight articles on the gill-fungi of tropical North America was concluded with a treatment of species having brown, purplish-brown, or black spores. On page 15 in the January number of that year the fourteen genera of the subtribe Agaricanae were keyed out, beginning with the sessile *Melanotus* and ending with *Coprinus* and *Clarkeinda,* in which the characters are more complex.

The present series of articles will deal with species occurring in temperate North America, except those confined to the Pacific Coast, which have already been considered for the most part in articles published in Mycologia some years ago. The key to the genera need not be repeated here. I shall, for convenience, begin with the larger, more fleshy species and take up the small, slender-stemmed ones later, reversing the natural order.

The three genera of the present article may be distinguished from others of the subtribe by a fleshy or fibrous stem, gills that do not deliquesce, and little or no veil, which does not form a definite ring on the stem. They may be separated from each other by the following key:

Lamellae adnate or adnexed.
  Hymenophore solitary or subcespitose, rarely densely cespitose; hygrophanous, viscid, or squamulose. *Drosophila.*
  Hymenophore densely cespitose; surface firm, dry, glabrous. *Hypholoma.*
Lamellae free. *Pilosace.*

Drosophila Quél. Ench. Fung. 115. 1886

Pileus hygrophanous, glabrous or nearly so, at least at maturity; spores pale, smooth.
  Pileus dark-colored; spores 5 x 3 μ. 1. *D. madeodisca.*
  Pileus light-colored; spores larger.
    Spores 9–12 μ long. 2. *D. pecosense.*
    Spores 7–9 μ long.

Pileus 1–2 cm. broad.	3. *D. fragilis.*
Pileus 2–6 cm. broad.	4. *D. appendiculata.*
Pileus floccose-scaly, grayish-white; spores small, dark, smooth.	5. *D. Storea.*
Pileus innately-fibrillose, becoming glabrous at times, some shade of reddish-brown; spores large, dark, distinctly tuberculose, and apiculate.	6. *D. lacrymabunda.*
Pileus glabrous, fibrillose, or squamulose; spores large, dark, smooth.	
Pileus glabrous, bay-brown; spores not apiculate.	
Surface moist, rugose.	7. *D. delineata.*
Surface viscid.	8. *D. Peckiana.*
Pileus large, reaching 10 cm. broad, densely and conspicuously covered with persistent, pointed scales.	9. *D. echiniceps.*
Pileus reaching 5 cm. broad, woolly or less conspicuously fibrillose-scaly.	
Spores apiculate.	10. *D. rigidipes.*
Spores not apiculate.	11. *D. hololanigera.*

1. **Drosophila madeodisca** (Peck) comb. nov.

Agaricus madeodiscus Peck, Ann. Rep. N. Y. State Mus. 38: 88. 1885.

Hypholoma madeodiscum Sacc. Syll. Fung. 5: 1039. 1887.

Hypholoma subaquilum Banning & Peck, Ann. Rep. N. Y. State Mus. 44: 70. 1891.

Pileus thin, convex to expanded, the margin often upturned, gregarious to densely cespitose, 2–6 cm. broad; surface hygrophanous, smooth or rugose, slightly atomate at times, dull-fulvous or chestnut-colored when moist, becoming grayish or isabelline when dry; margin thin, even, silky-fibrillose at first; context concolorous, hygrophanous, edible, with mild taste and no characteristic odor; lamellae crowded, adnexed or slightly sinuate, pallid to purplish-brown; spores short-oblong or oblong-ellipsoid, blunt at both ends, smooth, guttulate, pale-purplish-brown under the microscope, usually about 4.5 x 3 μ, rarely reaching 7 x 4 μ; stipe equal or somewhat thickened at the base, glabrous or slightly fibrillose, white or pallid, shining, usually hollow, 4–8 cm. long, 3–8 mm. thick; veil white, appendiculate, evanescent.

TYPE LOCALITY: Adirondack Mountains, New York.

HABITAT: On dead deciduous or coniferous wood, or in rich soil or leaf-mold in woods.

DISTRIBUTION: Eastern Canada to North Carolina and west to Colorado.

ILLUSTRATION: Mycologia 7: *pl. 158, f. 7.*

This species is very abundant in the northeastern United States, varying considerably in size and habit, but easily distinguished from *D. appendiculata* by its darker color and smaller spores, which are very blunt at both ends. When I described and figured it in MYCOLOGIA in 1915 as *H. Candolleanum,* I had not examined authentic European material, which shows at once much larger spores. *H. subaquilum* is represented at Albany by a dozen or more plants from Piseco and Lake Pleasant, New York, displayed on two herbarium sheets. Peck states that the spores are 4–5 μ long, which is correct. *H. madeodiscum* is represented by only three plants, which do not appear different from the specimens of *H. subaquilum,* and the spores measure 4–5 x 3 μ, although Peck describes them as 8–10 x 5–6 μ. A specimen at Albany determined as *H. madeodiscum* by Burt, who collected it in Vermont, has been changed by Peck to *H. appendiculatum.*

2. **Drosophila pecosense**[1] (Cockerell) comb. nov.

Hypholoma pecosense Cockerell, Jour. Myc. 10: 108. 1904.

Pileus 2.5 to nearly 4 cm. in diameter, slightly convex, sometimes slightly umbonate, margin nearly even, bearing remains of a veil as light-yellow, irregular scales; surface smooth, slightly inclined to be viscid, not at all striate, scaly or silky, creamy-white, more ochraceous on the disk, but always pallid; context not changing color on bruising or breaking, taste mild, not bitter; lamellae pale-purplish-gray, inclined to be white at the junction of the stipe, minutely white-furfuraceous on the edges; spores pale-purplish-brown under the microscope, broadly ellipsoid to slightly ovoid, 9–12 x 5–8 μ; stipe yellowish-white or very pale ochraceous, slightly striate from the very narrowly decurrent lamellae, white-furfuraceous, otherwise smooth and shining, hollow near the apex, 5.5 to nearly 9 cm. long.

TYPE LOCALITY: Pecos, New Mexico.

HABITAT: Unknown.

DISTRIBUTION: Unknown.

[1] Since the above was put into type I have located the original specimens sent by Cockerell to Earle and they prove to be a species of *Stropharia.* See my next article.

The author describes the spores as purple-brown, quite dark, oval, 12 x 8 μ; but the specimens show them to be as above noted.

3. **Drosophila fragilis** (Peck) comb. nov.

Hypholoma fragile Peck, Bull. N. Y. State Mus. 131: 22. 1909.

Pileus thin, fragile, conic or subcampanulate, becoming convex, obtuse or subumbonate, 1.2–2.4 cm. broad; margin thin, at first appendiculate with fragments of the white veil; surface floccose-squamulose when young, glabrous when mature, yellowish, grayish or subochraceous, sometimes more highly colored in the center; lamellae thin, narrow, crowded, adnate, whitish or pallid, becoming purplish-brown; spores 8–10 x 4–5 μ; stipe slender, fragile, stuffed or hollow, glabrous or minutely floccose, white or pallid, 2.5–5 cm. long, 2–3 mm. thick.

TYPE LOCALITY: Star Lake, St. Lawrence County, New York.

HABITAT: On decayed wood and leaves in damp woods.

DISTRIBUTION: Known only from the type locality.

ILLUSTRATION: Bull. N. Y. State Mus. 131: *pl. V, f. 1–7.*

The description of this species reads very much like that of *D. appendiculata,* but the specimens appear different. I find the spores ovoid to ellipsoid, smooth, pale-yellowish-brown under the microscope, 8–9 x 3.5–5 μ. The specimens from Painted Post are different, probably *D. appendiculata.* Fresh collections might enable one to place the species definitely under *D. appendiculata.*

4. DROSOPHILA APPENDICULATA Quél. Ench. Fung. 116. 1886

Agaricus appendiculatus Bull. Herb. Fr. *pl. 392.* 1788.

Hypholoma appendiculatum Quél. Champ. Jura Vosg. 115. 1872.

Agaricus saccharinophilus Peck, Ann. Rep. N. Y. State Mus. 25: 78. 1873.

Agaricus incertus Peck, Ann. Rep. N. Y. State Mus. 29: 40. 1878.

Agaricus hymenocephalus Peck, Ann. Rep. N. Y. State Mus. 31: 34. 1879.

Hypholoma cutifractum Peck, Bull. Torrey Club 22: 490. 1895.

Hypholoma flocculentum McClatchie, Proc. S. Cal. Acad. Sci. 1: 381. 1897.

Stropharia irregularis Peck, Bull. Torrey Club **27**: 16. 1900.

Pileus thin, fragile, ovoid or subcampanulate, then expanded, gregarious or cespitose, 2–6 cm. broad; surface hygrophanous, varying in color from white or pale-yellowish to light-brown or dark-honey-yellow, fading when old and dry, usually cracking with age, often radiately-wrinkled, glabrous or whitish-pulverulent, rarely floccose-scaly; margin sometimes purplish in tint, often wavy, adorned with fragments of the white, flocculent, fugacious veil; context thin, white, edible, of excellent flavor; lamellae adnate, crowded, narrow, white to purplish-brown, with the edges often uneven; spores ellipsoid or ovoid, smooth, purplish-brown, 7–8 x 4–4.5 μ; cystidia sac-shaped, 40 x 15 μ; stipe slender, equal, straight, hollow, easily splitting, white, glabrous below, pruinose or slightly furfuraceous at the apex, 2.5–7 cm. long, 2–6 mm. thick; veil white, appendiculate, evanescent or rarely persisting as an annulus.

TYPE LOCALITY: France.

HABITAT: On and about stumps, roots, trunks, and leaves of deciduous trees.

DISTRIBUTION: Temperate and tropical North America; also in Europe.

ILLUSTRATIONS: Atk. Stud. Am. Fungi *f. 26, 27;* Boud. Ic. Myc. **1**: *pl. 137;* Bull. Herb. Fr. *pl. 392, f. A, B, D;* Bull. Conn. Geol. Nat. Hist. Surv. **15**: *pl. 27;* Bull. N. Y. State Mus. **5**: *pl. 58, f. 13–20;* Bull. U. S. Dept. Agr. 175: *pl. 27, f. 2;* Cooke, Brit. Fungi *pl. 547 (587);* Gill. Champ. Fr. *pl. 130 (352);* Hard, Mushr. *f. 262;* Mem. N. Y. State Mus. 3: *pl. 60, f. 1–9;* McIlv. Am. Fungi *pl. 97a;* Murrill, Ed. Pois. Mushr. *f. 20;* Mycologia 4: *pl. 56, f. 1, 2;* N. Marsh, Mushr. Book, *pl. 22;* Pat. Tab. Fung. **1**: *f. 349;* Ricken, Blätterp. Deutschl. *pl. 64, f. 5;* Sow. Engl. Fungi *pl. 324;* Trans. Wisc. Acad. Sci. **17**: *pl. 83, f. C;* **18**: *pl. 22, 23.*

Two color forms of this common species have been figured in MYCOLOGIA. It is much paler than *D. madeodisca,* although resembling it in some respects. Some American mycologists have been uncertain regarding its identity, but Bulliard's figures *A, B,* and *D* are very clear. His figure *C* might be misleading, which, according to him, represents a sodden condition after long rains. The spores, like the plant, vary considerably. They are usually ellipsoid, 7–8 x 4–4.5 μ, but may be 5.5–9 x 4–5 μ. Few mushrooms are more delicate in flavor or more easily digested.

5. **Drosophila Storea** (Fries) comb. nov.

Agaricus Storea Fries, Epicr. Myc. 223. 1838.
Hypholoma lacrymabundum Quél. Champ. Jura Vosg. 113. 1872.
Stropharia cotonea Quél. Bull. Soc. Bot. Fr. **23**: 328. 1877.
Agaricus hypoxanthus Phil. & Plowr. Grevillea **13**: 48. 1884.
? *Agaricus populinus* Britz. Hymen. Südb. **4**: 157. 1885.
Hypholoma aggregatum Peck, Ann. Rep. N. Y. State Mus. **46**: 106. 1893.
Hypholoma Pseudostorea W. G. Sm. Jour. Bot. **41**: 286. 1903.

Pileus convex or subcampanulate to subumbonate, densely cespitose, 3–5 cm. broad; surface dry, white or grayish, darker and sometimes rugulose on the disk, ornamented with a few appressed, pale-umbrinous or avellaneous, floccose-fibrillose scales; context white, soft, watery, thick, thin at the margin, odorless, mild; lamellae adnate or sinuate, rather crowded, whitish, becoming dark-brown, whitish and sometimes weeping on the edges; spores oblong-ellipsoid, smooth, brown, 6–8 x 3–4 μ; stipe long, slender, equal, fibrillose, striate at the apex, white to discolored, often yellowish at the base when bruised, solid or hollow, 5–10 cm. long, 4–10 mm. thick; veil white, thick, often forming a fragmentary annulus.

TYPE LOCALITY: Sweden.

HABITAT: In rich soil in woods, usually about logs or stumps. It seems fond of beech.

DISTRIBUTION: New York, New Jersey, Michigan, and probably in other parts of the eastern United States; also in Europe.

ILLUSTRATIONS: Bull. N. Y. State Mus. 54: *pl. 79, f. 8–14;* Bull. Soc. Myc. Fr. 23: *pl. 2, f. 5;* Cooke, Brit. Fungi *pl. 543 (580);* Fries, Ic. Hymen. 2: *pl. 134, f. 1;* Mycologia 6: *pl. 113, f. 5.*

This species was first named by Fries from specimens collected by himself about beech trees in Sweden, the covering of matted hairs suggesting to him the specific name used. He saw it only twice, and it is rare in America, although several times collected about New York City. The plants first seen by Peck from Alcove were considerably smaller than the European form, but his variety *sericeum,* from North Bolton, is larger and smoother. Those interested in the rather complicated history of the species may refer to Maire's notes in Bull. Soc. Myc. France 27: 441–445. 1911,

or to condensed statements of his views by Kauffman under *H. lacrymabundum* in "The Agaricaceae of Michigan" and E. T. Harper in Mycologia **10**: 231–234. 1918. According to Kauffman, cystidia are present in this species, being rather abundant, ventricose, 30–40 x 12–15 μ.

6. DROSOPHILA LACRYMABUNDA (Bull.) Quél. Ench. Fung. 115. 1886

Agaricus lacrymabundus Bull. Herb. Fr. *pl. 194.* 1784.
Agaricus velutinus Pers. Syn. Fung. 409. 1801.
Hypholoma rugocephalum Atk. Stud. Am. Fungi 30. 1900.
Hypholoma Boughtoni Peck, Bull. N. Y. State Mus. 139: 23. 1910.

Pileus rather fleshy, ovoid to expanded, sometimes broadly umbonate, solitary or cespitose, 5–8 cm. broad; surface fulvous to isabelline with intermediate shades, darker on the umbo, covered when young with appressed, matted fibers, which may disappear with age or collect into small squamules, the cuticle cracking areolately at times; margin not striate; context very thin, concolorous, with a mild or slightly disagreeable taste, the odor not characteristic; lamellae rather crowded, sinuate-adnexed or adnate, somewhat ventricose, yellowish, shading to umber and spotted with black and rusty-brown as the spores mature, whitish on the edges; spores nearly lemon-shaped, apiculate, opaque, distinctly tuberculose, very dark-brown under the microscope, black in mass, 8–10 x 4–7 μ; cystidia abundant, 40 x 9 μ; stipe equal or slightly enlarged below, subconcolorous, nearly white at the apex, hollow, 5–10 cm. long, 8–12 mm. thick; veil of whitish, fibrous tufts adhering partly to the margin of the pileus and partly to the stipe.

TYPE LOCALITY: France.

HABITAT: In grass or weeds in the open or among leaves or about old stumps in thin woods.

DISTRIBUTION: Eastern United States; also in Europe.

ILLUSTRATIONS: Atk. Stud. Am. Fungi *f. 28, 29;* Bull. Herb. Fr. *pl. 194, pl. 526* (better); Cooke, Brit. Fungi *pl. 563 (582);* Mycologia 7: *pl. 158, f. 2;* Peck, Bull. N. Y. State Mus. 139: *pl. 2, f. 1–7;* Sowerby, Engl. Fungi *pl. 41;* Trans. Wisc. Acad. Sci. 17: *pl. 79;* and others.

This interesting species has received much attention from my-

cologists, both in Europe and America (See Mycologia 7: 116. 1915). The spores are distinctive, being apiculate and plainly tuberculose. *D. echiniceps,* with which it has been confused by some, has smooth spores and larger, more persistent squamules. Types of *Hypholoma rugocephalum* and *H. Boughtoni* have been carefully compared and prove to be only forms of Bulliard's original plant, which ranges through Europe as far northward as Sweden and through the northern United States westward to Minnesota. This species, which certainly is very distinct, was used as the type of three different genera proposed between 1886 and 1889 by Patouillard, Schroeter, and Fayod.

7. **Drosophila delineata** (Peck) comb. nov.

Hypholoma delineatum Peck, Bull. N. Y. State Mus. 150: 83. 1911.

Pileus fleshy, thin, convex to subumbonate, or nearly plane, often slightly depressed in the center, 2.5–5 cm. broad; surface moist, glabrous, rugose or radiately wrinkled, commonly marked toward and on the margin even when dry with irregular radiating lines or ridges, occasionally wavy or irregular on the margin and not striate, brown, tawny-brown, or reddish-brown, often darker on the disk; context whitish; lamellae thin, crowded, adnate, flesh-colored to brown, becoming blackish-brown with age or when bruised; spores smooth, ellipsoid, not apiculate, 8–10 x 4–6 μ; cystidia scarce, flask-shaped or broadly fusiform, 40–60 x 16–20 μ; stipe equal, glabrous or subfibrillose, hollow, pallid or colored like the pileus, 3–7 cm. long, 3–8 mm. thick.

TYPE LOCALITY: Port Jefferson, Suffolk County, New York.

HABITAT: On the ground or on decayed wood.

DISTRIBUTION: Massachusetts, New York, West Virginia, Indiana, and Missouri.

ILLUSTRATION: Trans. Wisc. Acad. Sci. 18: *pl. 21, f. D.*

8. **Drosophila Peckiana** (Kauffm.) comb. nov.

Hypholoma Peckianum Kauffm. Agar. Mich. 1: 258. 1918.

Pileus 1–2 cm. broad, convex, obtuse, subexpanded, margin bordered by white, silky fibrils from the remains of the veil, even; surface viscid, glabrous, bay-brown, blackish on the disk, paler on

the margin; context whitish, moderately thin, thicker at the center, odor and taste none; lamellae adnate, rounded behind, 2–3 mm. broad, abruptly narrower in front, close, at first flesh-colored, then dark-purplish-brown, white-fimbriate on the edges; spores ventricose-ellipsoid, pointed at each end, smooth, tinged with purple under the microscope, purplish-brown in mass, 10–12 x 5–6 μ; cystidia none; sterile cells on the edge of the lamellae clustered, linear-cylindric, obtuse, about 20 x 4 μ; stipe thick, equal, white-floccose above, innately-fibrillose elsewhere, pallid to brownish, brown within, except the white pith, at length hollow, flexuous, 3–4 cm. long, 2–2.5 mm. thick.

TYPE LOCALITY: New Richmond, Michigan.

HABITAT: On debris of leaves and decayed wood in woods of hemlock, beech, maple, etc.

DISTRIBUTION: Known only from the type locality.

9. **Drosophila echiniceps** (Atk.) comb. nov.

Hypholoma echiniceps Atk. Ann. Myc. **7**: 370. 1909.

Pileus convex, firm, fleshy, cespitose, 3–10 cm. broad; surface ochraceous-brown, with dense, pointed, seal-brown scales; context white, then changing to pale-saffron-yellow, with very slight taste and odor; lamellae somewhat narrowed in front, slightly rounded behind, adnate, rich-purple-brown with Indian-purple tint, whitish on the edges, 6–8 mm. broad; spores subellipsoid, inequilateral, the outer end sometimes slightly narrower, smooth as seen under oil immersion, 7–9 x 3.5–5 μ; cystidia cylindric, thin-walled, 10–12 μ thick, projecting 30–40 μ; stipe white, covered up to the evanescent annulus with fibrous, seal-brown scales, even, fleshy, fibrous, hollow, white to yellow within, 12–14 cm. long, 8–12 mm. thick; veil ample when young, becoming appendiculate and forming an evanescent, superior annulus.

TYPE LOCALITY: Ithaca, New York.

HABITAT: On the ground or about dead stumps or roots.

DISTRIBUTION: Ontario, New York, Pennsylvania, Ohio, Michigan, and Wisconsin.

ILLUSTRATIONS: Trans. Wisc. Acad. Sci. **17**: *pl. 77, f. B,* and *pl. 78.*

This species is confused by Peck with *D. lachrymabunda.* He had a number of collections from New York and elsewhere.

10. **Drosophila rigidipes** (Peck) comb. nov.

Hypholoma rigidipes Peck, Bull. N. Y. State Mus. 139: 24. 1910.

Pileus fleshy, thin, convex or broadly convex, gregarious, 2.5–5 cm. broad; surface dry, fibrillose-squamulose, tawny-brown, often reddish on the disk; context whitish, with a mild taste; lamellae close, narrow, slightly sinuate, adnexed, brownish-red, becoming dark-purplish-brown or black; spores ellipsoid, apiculate, 10–12 x 6–8 μ; stipe slender, rigid, equal, hollow, fibrillose-squamulose, concolorous or a little paler than the pileus, 5–10 cm. long, 4–6 mm. thick.

TYPE LOCALITY: North River, Warren County, New York.

HABITAT: Damp places among tall herbs.

DISTRIBUTION: New York and Massachusetts.

ILLUSTRATIONS: Bull. N. Y. State Mus. 139: *pl. 3, f. 1–6.*

The spores of Peck's type are slender, smooth, very dark, apiculate, 8.5–10 x 6–7 μ. Two collections made by me in the Adirondacks have spores that are narrower, more inequilateral, and somewhat lighter in color, measuring 9–10.5 x 5 μ. The plants are also much less fibrillose-squamulose, appearing almost glabrous in dried specimens. In spite of these differences, however, I hesitate to separate them as a distinct species.

11. **Drosophila hololanigera** (Atk.) comb. nov.

Hypholoma hololanigerum Atk. Ann. Myc. 7: 371. 1909.

Entire hymenophore covered with dense, long, delicate, whitish, fibrous scales. Pileus ovoid to convex, fragile, gregarious, 2–2.5 cm. broad; surface hygrophanous, watery-brown, becoming pale-ochraceous-buff to pinkish-buff on drying, not striate; lamellae elliptic, adnate, purplish-brown, whitish on the edges; spores sub-ellipsoid, slightly inequilateral, reddish-purple, smooth, 7–9 x 3.5–4.5 μ; cystidia ellipsoid, stalked, 40–50 x 12–15 μ; stipe slender, hollow, fragile, even, white with a very pale pink tint, 6–7 cm. long, 4–5 mm. thick.

TYPE LOCALITY: Ithaca, New York.

HABITAT: On very rotten wood in woods.

DISTRIBUTION: Known only from the type locality.

The type of this species has been destroyed by insects, leaving only the spores, a bit of stipe, and the description.

DOUBTFUL AND EXCLUDED SPECIES

Drosophila atrofolia (Peck) Murrill, Mycologia 4: 303. 1912. Specimens at Albany, so named by Peck, collected by Lloyd in Ohio, are specifically distinct from the types collected by McClatchie in California.

Hypholoma Candolleanum (Fries) Quél. Champ. Jura Vosg. 115. 1872. (*Agaricus Candolleanus* Fries, Obs. Myc. 2: 182. 1818.) Given the long name, *Agaricus violaceolamellatus,* by DeCandolle in Flora France 2: 153, which Fries changed as above. Some claim that it is not distinct from *D. appendiculata,* which often shows violet or purplish colors in its young gills at one stage and has similar spores. Specimens from Bresadola show smooth, broadly ellipsoid or ovoid spores measuring 7–9 x 4–5 μ. At Kew the two species seem exactly the same. Peck says his *H. madeodiscum* differs in having white gills at early stages. He has a sheet with plants from North Greenbush, New York, marked "*H. Candolleanum.* Spores 8–10 x 4–5 μ. *H. velutinum leiocephalum* B. & Br." Also a packet from Mt. McGregor. The characters usually ascribed to *H. Candolleanum* as distinct from *H. appendiculatum* are the violet color of the young gills, the darker color of the pileus, and the striations at the apex of the stipe.

Hypholoma comatum Atk. Proc. Am. Phil. Soc. 57: 355. 1918. Described from specimens collected at Ithaca, New York, in 1917. Type not seen.

Hypholoma confertissimum Atk. Proc. Am. Phil. Soc. 57: 355. 1918. Described from specimens collected near Oakland, Maryland, in 1917. Type not seen.

Hypholoma coronatum (Fries) Sacc. Syll. Fung. 5: 1038. 1887. (*Agaricus coronatus* Fries, Hymen. Eur. 295. 1874.) Reported several times from North America. Authentic specimens show it to be very near *D. appendiculata* (if not that species), with dentiform-appendiculate veil making the margin look like the edge of a crown, as shown in Fries, Ic. Hymen. *pl. 134, f. 3.* Morgan says *H. subaquilum* is *H. coronatum,* but that can not be true, because the spores of the latter measure 7–9 x 3.5–5 μ and are ellipsoid with rounded ends. At Albany, several specimens called *H. coronatum* by Peck are spread on a sheet marked "Menands, N. Y.,

Peck. Spores ellipsoid, 6–8 x 4–5 μ." These are considerably darker than typical specimens from Europe. Compare Kauffman's description, except that of the spores, with mine of *D. madeodisca.*

Drosophila hydrophila (Bull.) Quél. Ench. Fung. 116. 1886. Reported several times from America. Specimens so named by Peck, collected by Miss White in Maine, are *Psilocybe conissans* Peck. Kauffman retains the species in *Hypholoma,* rather than *Pilosace,* because the gills are "adnate-seceding." See his notes on page 266 of his book, where he refers to the disagreement regarding spores. I find them in specimens from Bresadola, who knows Bulliard's plants exceptionally well, to be broadly ellipsoid, blunt at the ends, smooth, pale-purplish-brown under the microscope, 4–5 x 3.5 μ—very near those of *D. madeodisca.*

Hypholoma populinum Britz. var., Kauffm. Agar. Mich. **1**: 261. 1918. Maire finds these subtriangular spores in *Drosophila Storea.*

HYPHOLOMA (Fries) Quél. Champ. Jura Vosg. 112. 1872

Pileus brick-red. 1. *H. lateritium.*
Pileus yellow, often red on the disk.
  Taste bitter. 2. *H. fasciculare.*
  Taste mild. 3. *H. capnoides.*

1. HYPHOLOMA LATERITIUM (Schaeff.) Quél. Champ. Jura Vosg. 112. 1872

Agaricus lateritius Schaeff. Fung. Bavar. Ind. 22. 1774.
Agaricus sublateritius Fries, Epicr. Myc. 221. 1838.
Agaricus perplexus Peck, N. Y. State Cab. **23**: 99. 1872.

Pileus convex to nearly plane, slightly umbonate at times, generally cespitose, 3–8 cm. broad; surface smooth, dry, glabrous, latericeous to bay; margin cream-colored to ochraceous; context mild or bitterish, white or nearly so, becoming yellow with age; lamellae adnate, somewhat rounded, sometimes slightly decurrent, thin, narrow, crowded, whitish or pale-yellow, becoming greenish, and finally purplish-brown from the ripening of the spores; spores ellipsoid, smooth, purplish-brown, 7–8 x 4 μ; cystidia few, 36 x 12 μ; stipe thick, subequal, firm, stuffed or hollow, glabrous or slightly fibrillose, stramineous above, ochraceous or reddish below,

ornamented with an arachnoid ring when young, which becomes conspicuous by reason of the spores which collect upon it, 5–12 cm. long, 5–12 mm. thick.

TYPE LOCALITY: Bavaria.

HABITAT: On or about old trunks or stumps of deciduous trees in autumn.

DISTRIBUTION: Eastern North America; also in Europe.

ILLUSTRATIONS: Atk. Stud. Am. Fungi *f. 25;* Bull. Conn. Geol. Nat. Hist. Surv. **3**: *pl. 25;* Bull. U. S. Dept. Agr. 175: *pl. 27, f. 1;* Cooke, Brit. Fungi *pl. 557 (572), pl. 558 (573);* Gill. Champ. Fr. *pl. 130 (357);* Hard. Mushr. *f. 265, 266;* Peck, Ann. Rep. N. Y. State Mus. **49**: *pl. 47, f. 11–18;* Peck, Mem. N. Y. State Mus. **4**: *pl. 60, f. 10–17;* Murrill, Ed. Pois. Mushr. *f. 19;* Mycologia **1**: *pl. 1, f. 1;* N. Marsh. Mushr. Book, *pl. 21, 23;* Richon & Roze, Atl. Champ. *pl. 25, f. 10–13;* Ricken, Blätterp. Deutschl. *pl. 65, f. 2;* Schaeff. Fung. Bavar. *pl. 49, f. 6, 7;* Trans. Wisc. Acad. Sci. **17**: *pl. 72, 73;* **18**: *pl. 19.*

This common autumnal species, which is ordinarily known as *Hypholoma sublateritium* or *H. perplexum,* was first described by Schaeffer as *Agaricus lateritius,* but on his plate he unfortunately used plants of *H. fasciculare* for the younger stages of his species, and this has caused confusion. Hudson referred to this plate and to Schaeffer's name when he described his *A. fascicularis.*

2. HYPHOLOMA FASCICULARE (Huds.) Quél. Champ. Jura Vosg. 113. 1872

Agaricus fascicularis Huds. Fl. Angl. ed. 2. 615. 1778.

Pileus fleshy, convex to expanded, often obtuse or umbonate, cespitose, about 5 cm. broad; surface dry, smooth, glabrous, sulfur-yellow or lemon-yellow, flavo-luteous to reddish-bay on the disk; context yellow, bitter; lamellae adnate, crowded, linear, sulfur-yellow, becoming greenish and finally olive-brown; spores ovoid or ellipsoid, smooth, very pale yellowish under the microscope, 6–7 x 3–4 μ; stipe slender, flexuous, smooth, glabrous or fibrillose, usually hollow, sulfur-colored to lemon-yellow; veil slight, fibrillose, pale-yellow.

TYPE LOCALITY: England.

HABITAT: Dead wood of all kinds.

DISTRIBUTION: Temperate regions.

ILLUSTRATIONS: Cooke, Brit. Fungi *pl. 561 (576);* Gill. Champ. Fr. *pl. 131 (354);* Hussey, Ill. Brit. Myc. **2**: *pl. 15;* Pat. Tab. Fung. **1**: *f. 116;* and others.

A common temperate species widely distributed on both coniferous and deciduous wood, and found in the greatest profusion on the Pacific coast. Plants found by me in Europe and America, and by Earle in Alabama, are recorded as having yellow, very bitter flesh. Several other specific names have been assigned to the plant in Europe. An old French chart includes it among the dangerous mushrooms.

3. HYPHOLOMA CAPNOIDES (Fries) Quél. Champ. Jura Vosg. 338. 1873

Agaricus capnoides Fries, Obs. Myc. **2**: 27. 1818.
Geophila capnoides Quél. Ench. Fung. 113. 1886.

Pileus fleshy, convex or nearly plane, obtuse, solitary or cespitose, 2.5–8 cm. broad; surface glabrous, dry, yellowish, often reddish or ochraceous on the disk; context white, with mild taste and odor; lamellae moderately close, adnate, dry, smoky-gray, becoming brown or purplish-brown; spores 7–8 x 4–5 μ; stipe equal or nearly so, silky, striate at the apex, sometimes curved or flexuous, hollow, pallid, 4–8 cm. long, 4–6 mm. thick.

TYPE LOCALITY: Sweden.

HABITAT: Stumps and logs of coniferous trees.

DISTRIBUTION: Throughout the northern part of North America; also in Europe.

ILLUSTRATIONS: Cooke, Brit. Fungi *pl. 559 (574);* Fries, Ic. Hymen. *pl. 133, f. 1;* Gill. Champ. *pl. 131 (353);* Harper, Trans. Wisc. Acad. Sci. **17**: *pl. 74;* Ricken, Blätterp. Deutschl. *pl. 65, f. 5.*

I have discussed this species in my articles on the fungi of the Pacific coast. Peck had a number of specimens, finding it alone, to the exclusion of *H. fasciculare*. Kauffman found neither species; Harper found both. Bresadola and I collected it in the Tyrol and I made the following notes from fresh specimens: "Looks like specimens I got in the Adirondacks. Smooth or cracked, glabrous, ochraceous, paler on the margin; veil slight, pallid, evanescent; gills pallid when young, adnate or adnexed,

rather distant, plane or arcuate; stipe smooth, shining, slightly fibrillose, pallid at the apex, darker and usually thicker below. Cespitose on dead pine wood. Flesh not noticeably bitter, lemon-yellow." Spores from these specimens are ovoid or ellipsoid, smooth, very pale yellowish under the microscope, 7–9 x 4–5.5 μ. Specimens collected by Earle in New York also had yellowish flesh and a mawkish (not bitter) taste.

DOUBTFUL AND EXCLUDED SPECIES

Agaricus (Hypholoma) Artemisiae Pass. Nuovo Giorn. Bot. Ital. **4**: 82. 1872. Reported by Peck from Brewerton, New York, but the specimens were later found to belong in *Hebeloma*.

Agaricus (Hypholoma) comaropsis Mont. Syll. Crypt. 122. 1856. Collected at Columbus, Ohio, by Sullivant. Types not seen.

Agaricus hirtosquamulosus Peck, Bull. Buffalo Soc. Sci. **1**: 53. 1873. Transferred to *Hypholoma* by Saccardo. Collected by Peck on maple logs in woods at Portville, Cattaraugas County, New York. Four specimens and a drawing are on the type sheet, where Peck has written "Not a good *Hypholoma. Naucoria.*" Specimens in a box at Albany from St. Louis, Missouri, collected by Glatfelter, have gills colored like the types, but the surface is darker and more hairy, as in *Naucoria pennsylvanica*.

Agaricus (Hypholoma) nitidipes Peck, Ann. Rep. N. Y. State Mus. **35**: 133. 1884. Collected by Peck at Albany, New York. The two poor specimens on the type sheet at Albany are marked by Peck "*Pholiota duroides.*" They certainly do not appear to be a species of *Hypholoma*.

Agaricus (Hypholoma) ornellus Peck, Ann. Rep. N. Y. State Mus. **34**: 42. 1883. *Pholiota ornella* Peck, Bull. N. Y. State Mus. 122: 151. 1908. See *Gymnopilus polychrous* (Berk.) Murrill, N. Am. Fl. **10**: 204. 1917.

PILOSACE (Fries) Pat. Hymén. Eur. 122. 1887

In MYCOLOGIA for March, 1918, I discussed this genus from the standpoint of the two tropical American species assigned to it by Fries. It differs from *Agaricus* in lacking a veil. In 1904 Peck

characterized it as agreeing with *Pluteus,* but having black or purplish-brown spores. He mentioned 2 species from Europe, 2 from the West Indies, 1 from Africa, and 1 from the United States, this last being his *Pilosace eximia,* which is discussed elsewhere in the present number of MYCOLOGIA.

According to Harper, our *Stropharia epimyces* (Peck) Atk. is not distinct from *Pilosace algeriensis,* but he can not suggest to what group of fungi the species may belong. According to Kauffman, who retains it in *Stropharia,* "our plant is not a *Pilosace.*" Fries based his subgenus *Pilosace* on *Agaricus tricholepis,* definitely characterized by *free gills,* and Patouillard subsequently raised it to generic rank.

NEW YORK BOTANICAL GARDEN.

A NEW SPECIES OF MYRIANGIUM ON PECAN

L. E. Miles

(With Plate 14)

On the living bark of the pecan, *Carya illinoensis,* in southern Mississippi, as well as elsewhere, probably throughout the entire range of the host, one finds a black fungus growth, sometimes in considerable abundance. It is quite superficial in character, occurring in the form of wart-like or knob-like tubercles on the unspotted and uninjured younger bark. But rarely, if ever, is it found on the rough, scaly portions, and never has it been observed growing on dead trees. It is found on all varieties of the host tree, more abundantly on those trees which have suffered somewhat from neglect and lack of proper care, but occasionally is abundant in thrifty, well-cared-for orchards. It has never been observed on the hickory, though it has been seen on pecan limbs and twigs which had been top-worked onto that tree.

Though quite superficial and apparently causing no injury to the host, the fungus is an object of considerable concern to growers in that it mars the appearance of their trees. It is the cause of numerous inquiries, and, therefore, it has been deemed worth while to devote some little attention to it. Although superficially described and pictured by McMurran and Demaree,[1] the causal organism has never been determined.

Morphology

The tubercles vary in size, ranging from 1 millimeter to 3 or 4 millimeters in diameter. The shape also varies, but isolated specimens usually approximate the hemispherical in form. Often a number of them are found crowded together, but rarely do they become confluent. The color varies from a very dark reddish-black to a coal-black. The surface is usually considerably con-

[1] McMurran, S. M., and Demaree, J. B.: Diseases of Southern Pecans, U. S. Farmers' Bulletin No. 1129 (1920), p. 20.

voluted or verrucose, sometimes almost papillate, almost never smooth. The tubercles are solidly attached to the bark by a narrower, stipe-like portion which appears to penetrate through the outer corky portion into the living phloem tissue.

The inner portion of the tubercle is reddish-brown in color, and is densely and uniformly pseudoparenchymatic in structure, with a very thin, darker, crust-like layer on the outside. Occasionally streaks of slightly darker, thicker-walled cells will be found extending through this uniform tissue. Such streaks are usually located a short distance beneath the beginning of the loculiferous region. This portion, in which the asci occur, lies near the periphery of the tubercle, just beneath the crust-like layer, and on the outer side of each of the convolutions.

The locules are closely crowded together, often being separated by only one or two rows of the pseudoparenchymatous stromatic cells. They are subglobose to broadly ovate or oval in form and occur in several layers, some of the outer convolutions being almost entirely loculiferous. In microtome section this portion of the tubercle-like stroma has a very open, porous appearance. Even when cut with a knife in the natural condition while still attached to the tree, this locule-bearing tissue has a gray, powdery appearance in contrast to the dark brick-red or brownish-black of the solid, homogenous, sterile portion beneath it.

Each locule is lined with a thick, hyaline sheath, inside which occurs a single ascus. When the stroma is crushed and examined under the microscope, this sheath easily separates from the tissue of the stroma and remains about the ascus, giving the appearance of being merely a very thick ascus wall. If the sheath becomes ruptured, however, the ascus immediately expands, chiefly in a longitudinal direction, often to two or two and one half times its original length, becoming oblong, broadly spindleform, or ovate with blunt rounded ends, while the ruptured locule sheath collapses about its base. The ascus wall is quite thin as compared with this sheath, except at the apical end, where it is heavily thickened. There is no apical pore and the method of spore discharge has not been observed. Since the locules are indehiscent, and the pore at the apex of the ascus is absent, this probably is brought about by

the irregular rupture of the ascus wall. Each ascus contains eight spores. There are no paraphyses.

The locules average 50 x 50–50 x 60 μ while still in position in the stroma. When freed they become more oval in form, probably due to the expansion of the ascus on absorbing water, when they average 62–65 x 40 μ. The ascus entirely fills the locule, but after the rupture of the sheath has occurred it becomes 90–95 μ in length, contracting but little at its broadest part, the middle, but considerably toward each end.

The spores are multiseptate-muriform, large, oblong, and straight or sometimes slightly curved. They are seven- to eight-septate, with the middle septum much more definite than either of the others. There may be a slight constriction at either of the cross septa, but it is always more pronounced at this middle septum. The longitudinal septations are irregular, as are the others, with the exception of the middle one, dividing the spore into irregular somewhat cubical portions. When observed from the end in optical section the spore appears to be built about a very small, hollow central core, the segments being arranged about this very much in the manner of the grains on the cob of an ear of corn, when it, likewise, is observed from the end. The segments, however, are much fewer in number than in this latter case, the average number about the central core being 5 to 7. The spores average from 25–28 μ in length by 10–11 μ in breadth. They are ordinarily observed to be hyaline, but in quite mature specimens they have a very faint yellowish tint.

IDENTITY

The morphology of the fungus, especially the character of the indehiscent, monoascicular loculi scattered throughout or rather grouped toward the periphery of a pseudoparenchymatous stroma point at once to the family Myriangiaceae. The resemblance of members of this family to the Tuberales has been pointed out by Saccardo and Engler and Prantl. They exclude them from that order on account of their aërial, parasitic or saprophytic habit, and their general appearance. Von Höhnel monographed this family in 1905 and places it in the Discomycetes close to the Tuberales.

The fungus appears to fall in the genus *Myriangium* as revised by Von Höhnel, and since it does not agree with any species described under it, the following name is proposed:

Myriangium tuberculans sp. nov.

Stromatibus tuberculi-formibus, primo immersis, demum superficialibus, solitariis vel gregariis, firmiter affixis, 1–3 vel 4 mm. diam., irregulariter hemisphaericis, ruguloso-verrucosis vel subpapillatis, interdum mutua pressione angulosis, atris, vel rufobruneis, intus atrosanguineis, vel fusco-bruneis, contextu pseudoparenchymaticis; loculis numerosis, subpolystichis, subperiphericis, globosis vel ovatis, monoascis, indehiscentibus; ascis subglobosis vel ovatis, crasse tunicatis, 8-sporis, aparaphasatis, 62–65 x 40 μ; sporidiis oblongis, rectis vel leniter curvulis, utrinque obtusis, tranverse 7-septatis, muriformiter divisis, ad septa leniter constrictis, hyalinis, vel demum subflavidulis, 25–28 x 10 μ.

HABITAT: In cortice vivo Caryae illinoensis, Mississippi, America boreale.

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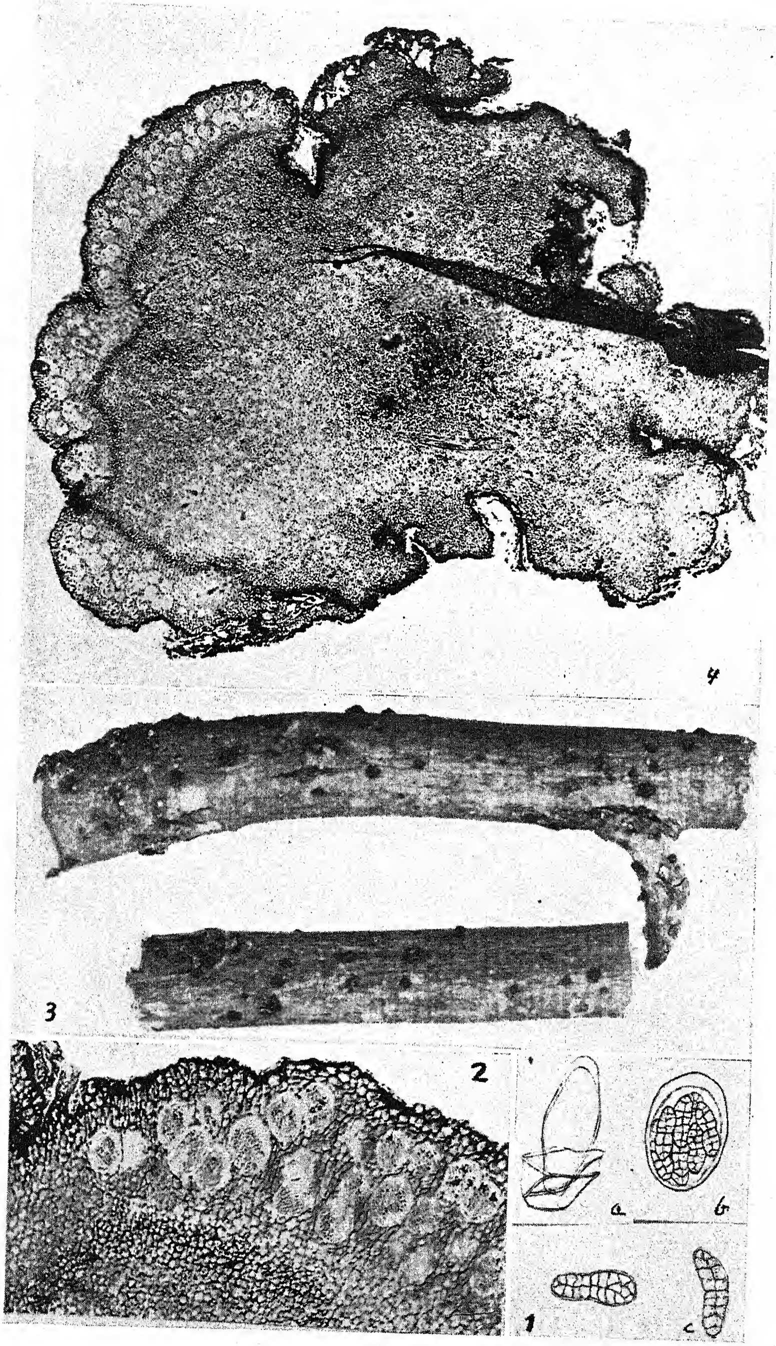
EXPLANATION OF PLATE 14

Fig. 1. (*a*) An expanded ascus with the ruptured sheath collapsed about its base; (*b*) an ascus with its spores, surrounded by the enveloping sheath which resembles a thickened ascus wall; (*c*) spores.

Fig. 2. Peripheral loculiferous portion of stroma as represented in figure 4, enlarged.

Fig. 3. Twigs of *Carya illinoensis* bearing the stromata of the fungus.

Fig. 4. Section through a stroma showing pseudo-parenchymatic structure and loculiferous region located near periphery.



Myriangium tuberculans Miles

NEW JAPANESE FUNGI

NOTES AND TRANSLATIONS—XI

Tyôzaburô Tanaka

Helminthosporium Oryzae Miyabe & Hori sp. nov. ex S. Hori in Nôji Shikenjô Hôkoku (Bulletin of the Agric. Exper. Station), Nishigahara, Tôkyô, no. 18: 67–84. M. 34, xi, Nov., 1901. (Japanese); Saccardo, Sylloge fungorum 22: 1394. 1913 (nom. nud.); Oudemans, Enum. syst. fung. 1: 723. 1919 (nom. nud.).

Spots scattered or grouped, fuliginous or soot-color, velvety; conidiophores fascicled, 2–5 in group meeting rather loosely at the base, dark-brown, more or less bending, 7–15-septate, lowermost cell largest, rather rounded and swollen, width of cells gradually reduced toward the apex, terminated by blunt, thin-walled, light-colored or almost colorless cell, 100–330 x 6–8 μ; conidia lunate or obclavate bending to one side, obtuse at both ends, easily detached, pale-olivaceous of sooty shade, 6–11-septate, only slightly constricted at the septum, contents finely granular, 84–140 x 16–22 μ, germinating at both ends.

Parasitic on culms, leaves, and glumes of *Oryza sativa*.

Type localities: Experimental farm of the Imperial Agricultural Experiment Station, Nishigahara, Tôkyô, Sept., 1900 (S. Hori); Tôkyô-fu Minamitama-gun Motohachiôji-mura, Sept. 26, 1900 (S. Hori); Okayama-ken, Sept., 1900 (T. Nishida).

Japanese name of the disease: Ine Goma-hagarebyô (Sesame-spot leaf blight of rice plant) *ex* Hori in Dainippon Nôkwaihô (Journ. Agric. Soc., Japan), no. 380: 6. Feb., 1913. (Japanese.)

Hori later revised the description as follows: Conidiophores 2–3-fascicled, brownish, 100–330 x 7.2 μ; conidia 6–10-septate, fuscous. *See* Hori's Nôsakumotsu Byôgaku (Discourse on diseases of agricultural crops), Tôkyô, Seibidô, June, 1911, pp. 106–107. (Japanese.)

Illustration: Hori's original drawings of conidia and conidiophores are seen in the book above mentioned (p. 107). Ideta's

Handbook (*see* Mycologia 9: 167), p. 744, also gives fairly good illustrations of the fungus.

Both paddy and upland rices are infected. The fungus usually appears as minute spots on the leaf blade, about the size of sesame seeds, often elongated or confluent, forming larger spots. In such infected leaves, especially when the plant is young, the discoloration and withering soon follow, proceeding from the leaf-tip, often causing death of the entire plant. In an advanced stage of the disease characteristic brown velvety bodies are produced from the surface of the diseased spots.

K. Hara (in Hara's Ine no Byôgai, Diseases of the rice plant, Gifu-ken, June, 1918, p. 61, in Japanese) states that the Japanese rice blight fungus might be identical with that which had been described by Breda de Haan as *Helminthosporium Oryzae* (in Bull. l'Instit. Bot. Buitenzorg., no. 6: 11. 1900), though the description of the latter is rather imperfect. The present species, however, differs very strikingly from *H. macrocarpum* Grev. in the shape of the conidia which are obclavate or fusoid, whereas in the latter they are simply clavate (refer Fig. 249 CH of Engler & Prantl, Nat. Pflanzenfam. I, 1**: 479).

The disease was first known in Japan about 1895, but is now established everywhere as far as Formosa. Recently prevention through seed treatment and spraying with various kinds of fungicides has proved to be effective. *See* Nishikado, Y., in Byôchûgai Zasshi (Journ. Pl. Prot.), 5^9: 693–712, Sept., 1918, and Suyematsu, N., ditto, 7^1: 26–29, Jan., 1920 (both in Japanese). In a series of inoculation tests, a number of rice-plant varieties as well as wild grasses was examined by Suyematsu in connection with the susceptibility and resistance to the *Helminthosporium* rice blight. *See* Suyematsu, N., in Nôgaku Kwaihô (Journ. Sci. Agric. Soc.), Tôkyô, no. 212: 279–286, Apr., 1920; no. 214: 443–446, June, 1920; and no. 217: 655–657, Oct., 1920. (All in Japanese.)

GLOMERELLA CINNAMOMI Yoshino sp. nov. in Shokubutsugaku Zasshi (Bot. Mag.) Tôkyô, 21^{248}: 230–232, Pl. 5. M. 40, ix, Sept., 1907. (Japanese.)

Mycelia first colorless, later fulvous, hyphae mostly colored in

substratum, septate, 2–3.5 μ across; acervuli of conidial stage (Gloeosporium) minutely tuberculate, subepidermal, later erumpent, light pink in color; stromata disciform, brown; conidiophores densely seated on the stroma; conidia oblong, frequently ovoid ellipsoid or cuneate, often slightly curved, without guttulae or 1–2-guttulate, colorless, light pink in mass, variable in size but chiefly 10–18 x 4–6 μ; perithecia subepidermal, black punctiform, solitary or two together, globose or depressed-globose, slightly raised at the apex with orbicular ostiola 17–20 μ wide, brown or brownish-blue, 100–150 μ in diam.; asci numerous in one perithecium, fusoid, broad at the middle, narrowed near the apex, wall often thickened at the apex but not stained by iodine, 46–60 x 8–13 μ, octosporous, aparaphysate; ascospores oblong, narrowed at both ends, usually curved, hyaline, non-guttulate or guttulate, 10–15 x 3.5–5 μ.

On *Cinnamomum camphora,* infesting leaves, petioles, leaf-buds, and young shoots in the nursery, causing considerable damage. Old plants are also infected. Diseased spots are usually orbicular, elliptical, or fusiform, 3–5 mm. in diam., first reddish-brown, later becoming fuliginous, finally fading into light-brown. The infected area is definitely marked from the healthy part, usually sunken, and when severely affected the infected areas become confluent, causing brown rot of the surrounding part, finally girdling the stem and killing the entire plant.

TYPE LOCALITIES: Kumamoto-ken. Yatsushiro-gun, Dec. 29, 1905 (T. Tejimazaki); Kikuchi-gun Waifu-chô, Oct. 25, 1906 (K. Yoshino); Hôtaku-gun Ôe-mura, Nov., 1906 (K. Yoshino); Ashikita-gun Hinagu-chô, Dec., 1906 (K. Yoshino); Hôtaku-gun Kawachi-mura, May 12, 1907 (T. Nishida); and Saga-ken Saga-shi, Nov., 1906.

ILLUSTRATION: One copper plate giving ten figures, showing the diseased plant, conidial layer, germination of conidia, perithecia, asci, ascospores, and germination of ascospores.

DISTRIBUTION: Formosa. *See* Sawada, K., in Taiwan Hakubutsu Gakkwai Kwaihô (Journ. Formosan Nat. Hist. Soc.), no. 25: 131–133. T. 5, x, Oct., 1916. (Japanese.)

Sawada states that the outbreak of the disease in the nursery and young plantation of camphor trees near Taihoku caused much damage in the spring of 1913. The Formosan fungus generally agrees with that described from Kyûshû by Yoshino, with the exception

of the smaller size of the ascospores, which Sawada finds to measure 12–13 x 5.5–7 μ. Sawada also revises the description of the fungus as follows: "Conidiophores straight or more or less curved, simple, hyaline, 16–27 x 3.5–4 μ; asci clavate-fusoid or fusoid, 53–67 x 8–8.5 μ."

Hara in Shokubutsugaku Zasshi (Bot. Mag.) Tôkyô, 27^{317}: 272 (Japanese) suggests to call the present species *Guignardia Cinnamomi* (erroneously spelled *cinnamomii*) on account of the lack of the stroma which should be present in *Glomerella*.

PHYSODERMA MAYDIS Miyabe in A. Ideta, Nippon Shokubutsu Byôrigaku (Handbook of plant diseases of Japan) ed. 4, Tôkyô, Shôkwabô, M. 42, 1909, part 1: 114, fig. 19. (Japanese.)

Cladochytrium sp. nov. K. Sengoku, in Ehime-ken Nôkwaihô Journ. Agr. Soc., Ehime prefecture) no. 32: 58, M. 34, xii, Dec., 1901. (Japanese.)

Cladochytrium Maydis Miyabe in Ideta's Nippon Shokubutsu Byôrigaku (Handb. Pl. Dis., Japan)[1] ed. 3, Tôkyô, Shôkwabô, M. 36, 1903, p. 75 (nomen nudum): Omori, J. & Yamada, G. Shokubutsu Byôrigaku (Plant pathology) Tôkyô, Hakubunkwan, M. 37, 1904, p. 202 (nomen nudum).

Occurs on the parenchymatous cells of the culm, midrib of the leaves, and the lower part of the husk, producing numerous orbicular, elliptical, or linear spots; spots mostly small-sized, often confluent, brown or fuliginous, light-colored near the margin, much deeper at the center; sporangia ellipsoid-ovate or globose, deep-brown, 24–26 x 22–24 μ.

Parasitic on *Zea Mais*.

[1] Referring to Ideta's Handbook of Plant Diseases here quoted, the first and second editions were published in 1901 and in 1902, respectively, under the title Jitsuyô Shokubutsu Byôrigaku (Practical discourse on plant diseases); the third edition, issued in 1903, was greatly enlarged and largely rewritten, and bears a new title, Nippon Shokubutsu Byôrigaku; it is called the third edition in the German title page only. The fourth edition, which came out under the same title, was issued originally in two parts, the first in 1909 (pp. 1–344) and the second in 1911 (pp. 345–935, with appendices), and is really a new work written under the critical supervision of Prof. K. Miyabe, who contributed diagnoses of some of his new species published here for the first time. Unaltered reprints of the fourth edition were issued in 1912 and in 1914, sometimes called fifth and sixth editions.

The disease does not usually prevent fruiting, but sometimes does when it occurs abundantly in the early stage of the host plant. In 1901 the disease was first discovered by K. Sengoku in the prefecture of Ehime, Shikoku island, and the above description is probably based upon the material collected at this time. It has not been reported from any other locality in the Japanese territory.

ILLUSTRATION: One black-and-white wood-cut figure showing sporangia.

Notes: *Physoderma zeae-maydis* Shaw, first reported from India (Sydow, H., Sydow, P., & Butler, E. J., in Annales mycologici $\mathbf{10}^3$: 245–247, fig. 2. 1912), and now known as the causal organism of one of the worst diseases of corn in the United States (*see* Tisdale, W. H., in Journ. Agr. Res. $\mathbf{16}^5$: 137–154, 10 pls., Feb., 1919), is, in many respects, identical with the present species, though no actual comparison of the organism has yet been carried out. Plant quarantine against this fungus was announced by the U. S. Department of Agriculture in 1916 (*see* Notice of Quarantine No. 24. 1916).

MYCOSPHAERELLA BAMBUSIFOLIA Miyake & Hara sp. nov. in Shokubutsugaku Zasshi (Bot. Mag.) Tôkyô, 24^{286}: 338–340, M. 43, xi, Nov., 1910. (Japanese.)

Foliicolous; pycnidia punctiform, black to the naked eye, immersed, globose or depressed-globose, fuliginous, open at the apex, 70–100 x 60–90 μ; pycnospores abundant, oozing from pycnidial opening when mature, ellipsoid ovoid or cylindrical, hyaline, 2–3.5 x 1–1.5 μ; pedicels minute; perithecia mixed with the pycnidia, globose or depressed-globose, 70–100 μ broad, 90–100 μ high, rarely 60 μ in diam.; wall thick, fungoid-parenchymatous, fuscous or black, ostiola as high as the epidermal plane or slightly raised; asci many, fasciculate, oblong-ovoid and more or less stipitate below or fusoid-lunate and obtuse at both ends, 37–50 x 9–10 μ, octosporous, aparaphysate; ascospores distichous, ovoid or ellipsoid, uniseptate, usually not constricted, hyaline, at first granular, usually becoming homogeneous later, 13–16 x 4.5–5 μ.

Parasitic on *Phyllostachys puberula* and *Phyllostachys bambusoides.*

Infected leaves develop round, elliptical, or irregular fuscous

spots of black periphery, which often run together in increasing size, finally causing death of the surrounding area. This gives the leaves a brownish appearance, and when they are severely infested the entire bamboo grove appears badly discolored and seriously injured. Later fruiting bodies make their appearance on the discolored area as minute black spots.

TYPE LOCALITIES: Gifu-ken Ena-gun Tôyama-mura and Kawauye-mura, Apr., 1908; Tôkyô Komaba, May, 1909.

Differs from *Mycosphaerella Arundinariae* Atk. (Bull. Corn. Univ. 3^1: 9. 1897) in the absence of brown hyphae around the perithecium, and in the shape and size of the asci and ascospores.

PHAEOSPHAERIA BAMBUSAE Miyake & Hara sp. nov. in Shokubutsugaku Zasshi (Bot. Mag.) Tôkyô, 24^{286}: 340–341, M. 43, xi, Nov., 1910. (Japanese.)

Foliicolous; spots appear along the vein, often with indefinite margin, brown or dark-colored, later becoming grayish or fuscous from the middle, finally covering the entire leaf; perithecia minutely punctiform, scattered or along the veins, immersed, globose or depressed-globose, black, 120–170 x 140–210 μ; wall rather thin, dark-colored or fuscous, ostiolate at the apex; asci numerous, fascicled, clavate or cylindrical, 65–90 x 18–27 μ, octosporous, aparaphysate; ascospores distichous or irregular, fusoid or ellipsoid, straight or slightly curved, triseptate, constricted, hyaline and granular when young, dark-colored with age, 25–30 x 10–12 μ.

Phyllosticta stage usually makes its appearance with the ascigerous stage on the same diseased spot as it does in the case of *Phaeosphaeria Oryzae* Miyake. (*See* Journ. Coll. Agric., Imp. Univ. Tokyo 2^4: 247. 1910.) The description of this form follows:

Pycnidia immersed, globose or depressed-globose, ostiolate at the apex, 100–140 x 70–100 μ; pycnospores ooze from the pycnidial opening when mature, ellipsoid or cylindrical, hyaline, 2–2.5 x 1.1–3 μ.

On the living leaves of *Arundinaria Simoni* and *Sasa paniculata*.

TYPE LOCALITIES: Tôkyô Komaba, July, 1906 (D. Karashima), July, 1910 (I. Miyake & K. Hara); Tochigi-ken Nikkô, Aug., 1910; Gifu-ken Ena-gun Kawauye-mura, Aug., 1910 (on the second host).

USTILAGINOIDEA SACCHARI-NARENGAE K. Sawada sp. nov. in Taiwan Hakubutsu Gakkwai Kwaihô (Journ. of Formosan Nat. Hist. Soc.) 4^{15}: 4–5. T. 3, v, May, 1914. (Japanese.)

Ovary infesting, appearing in group on the ear of the host plant, dark olive in color, balloon- or top-shaped, rounded at the apex, 3 mm. long, first covered by a membrane, later rupturing at maturity, exposing the dark-olive spore mass inside, lower part of the mass being associated with glume and palea, hard, sclerotium-like, inside of the mass white or very light straw-color, composed of closely arranged angular cells; spores globose or ovoid, covered with comparatively large-sized warts, dark-olive, 4–5.5 usually 4.5–5 μ.

Parasitic on *Saccharum narenga.*

TYPE LOCALITY: Akôchô Hanshoryô Keishûshô, Formosa, Dec. 10, 1907. (Y. Shimada.)

The cross-section of the sclerotium-like body is entirely parenchymatous, and no parallel hyphae are visible as in the case of *Ustilaginoidea Oryzae* Bref.

PLASMOPARA WILDEMANIANA P. Henn. var. MACROSPORA K. Sawada var. nov. in Taiwan Hakubutsu Gakkwai Kwaihô (Journ. Formosan Nat. Hist. Soc.) no. 16: 2–4. T. 3, vii, July, 1914. (Japanese.)

Foliicolous; spots irregular, often occupying the entire leaf, light yellowish-green, white mouldy on the lower surface; hyphae in mesophyl intercellular, invading the cell only by haustorium, colorless, continuous, branching, 7–13 μ thick; haustoria globose or ovoid-globose, 13–17 x 9–18 μ; conidiophores fascicled from the stoma, upright, 320–605 μ long, main axis 8–12 μ thick, slightly swollen at the base, first branching at about one half or one third of the whole length from the base, usually branching 5 to 7 times, terminal branchlets (commonly 4–8 μ long) and their underlying branchlets very short; conidia ovoid or elliptic-ovoid, rounded at the apex, papillate at the base, colorless, 14–18 x 11–13 μ.

Parasitic on the leaf of *Justicia procumbens.*

TYPE LOCALITY: Formosa. Taihokuchô Chônaihoshô, Sept. 12, 1908 (Y. Fujikuro), Apr. 5, 1913 (Y. Fujikuro).

The present variety has noticeably larger-sized conidia than those of the type species described by P. Hennings and later by Sydow

and Butler. (*See* Wildeman, E., Études Flor. Bas- & Moyen-Congo, Sér. 5. II²: 85. 1907, and Ann. Mycol. 10³: 243–244. fig. 1. June, 1912.) Sawada suggests that more noticeable difference may be revealed if they are closely compared as in the case of species of *Bremia*. (*See* Mycologia 11²: 84–86. March, 1919.)

COLLETOTRICHUM BOEHMERIAE K. Sawada sp. nov. in Taiwan Hakubutsu Gakkwai Kwaihô (Journ. Formosan Nat. Hist. Soc.) no. 17: 2. T. 3, ix, Sept., 1914. (Japanese.)

Foliicolous or caulicolous; spots scattered, cinereous with brown margin, orbicular and 1–2 mm. diam. on leaves, when on stem, forming orbicular, elliptical or fusiform spots, occasionally causing longitudinal rupture of the host epidermis, 1–6 x 0.8–2 mm. in size; hyphae colorless, 4 μ thick; acervuli small, with setae; conidiophores dense, short, terminated by conidia; conidia colorless, cylindrical or occasionally clavate, straight, obtuse at both ends, granular, 14–19 x 4–5 μ; setae dark-brown, tapering toward the apex, 1–2-septate, 45–85 x 4–5 μ.

Parasitic on Ramie (*Boehmeria nivea*).

TYPE LOCALITY: Taihokuchô Chônaihoshô, Formosa. June 29, 1914 (A. Imachi).

Stem infection causes bad staining of the bast fibers, which is hardly removable when the fibers are bleached. The infected plant, therefore, yields only lower grade fibers of less commercial value.

CERCOSPORA PIRICOLA K. Sawada sp. nov. in Taiwan Hakubutsu Gakkwai Kwaihô (Journ. Formosan Nat. Hist. Soc.) no. 17: 3. T. 3, ix, Sept., 1914. (Japanese.)

Hypophyllous; spots usually angular, occupying certain area enclosed by veinlets, later coalesce, often cover the entire surface, cinereous, later changing into brown, generally 1–3 mm. in diam.; conidiophores fascicled, several or more than ten together, straight or curved, cinereous, 0–2-septate, 15–27 x 3–4 μ; conidia linear, curved, 3–5-septate, grayish or almost colorless, 28–57 x 2.5–3.5 μ.

On *Pirus communis* (pear) and *Pirus sinensis* (sand-pear).

TYPE LOCALITIES: Formosa. Taihokuchô Chônaihoshô, Jan. 15, 1910 (Y. Fujikuro), Sept. 2, 1911 (K. Sawada); Taichûchô Tai-

heishô, Aug. 6, 1911 (Y. Fujikuro); Kagichô Toroku, Apr. 30, 1913 (K. Sawada).

Resembles *Cercospora minima* Tracy & Earle (Bull. Torr. Bot. Cl. 23^5: 206. May, 1896) on pear from America, but differs in being hypophyllous and in having longer conidiophores and shorter but thicker conidia of grayish color, while the American species is characterized by being epiphyllous and having shorter conidiophores and slender and hyaline conidia.

The extent of injury due to this fungus is not known.

USTILAGO FORMOSANA K. Sawada sp. nov. in Taiwan Hakubutsu Gakkwai Kwaihô (Journ. Formosan Nat. Hist. Soc.) no. 34: 6–8. T. 7, v, May, 1918. (Japanese.)

Infesting inflorescence and the upper part of the culm; sori linear, fuliginous, 2.5–14 cm. long, at first enclosed by grayish-white membrane, later escaping from enclosing sheath, ruptures and emits black spore mass inside, leaving only fibrous tissue behind; spores globose or subangular-globose, light reddish-brown, containing granules, 5–7 μ generally 5.5–6 μ in diam.; epispore apparently smooth, but finely echinulate under close observation; promycelia very short and continuous, or somewhat longer and uniseptate, producing sporidia at the end or at the joint between two cells, 8–17 x 1–3 μ; sporidia fusoid to oblong-fusoid, often producing secondary sporidia thereupon, 3–6 x 1–2 μ; germinating tube sometimes formed on the promycelium.

On *Panicum proliferum.*

When the disease occurs in the field, whole culms arising from common root are infested.

TYPE LOCALITIES: Formosa. Taihokuchô Chônaihoshô, May, 1906 (S. Suzuki), Apr. 22, 1907 (Y. Fujikuro), Aug. 10, 1908 (Y. Fujikuro), Nov. 27, 1908 (K. Sawada), Dec. 4, 1908 (K. Sawada); Tôenchô Nanseishô, June 2, 1917 (K. Sawada); Taitôchô Daimabukutsu, Apr. 29, 1909 (K. Sawada); Taitôchô Toran, May 21, 1911 (K. Sawada).

Differs from *Ustilago Panici-proliferi* P. Henn., which occurs on *Panicum proliferum acuminatum* in America, in having distinctly smaller spores.

BUREAU OF PLANT INDUSTRY,
WASHINGTON, D. C.

NOTES AND BRIEF ARTICLES

[Unsigned notes are by the editor]

Dr. Murrill visited the State Museum at Albany early in February to study types of certain species of dark-spored gill-fungi in collections made by the late Dr. Peck.

Prof. H. M. Fitzpatrick, of Cornell University, spent several days at the Garden late in January examining specimens of an interesting group of Pyrenomycetes, which he is monographing. He also visited the mycological herbaria at Washington, Philadelphia, and Boston.

Mr. Harold E. Parks, whose articles on underground fungi have been read with so much interest, has been appointed technical assistant and collector in the Department of Botany at the University of California. His address is no longer San Jose, but Berkeley.

Supplementary lists of species of smuts and rusts occurring in Indiana, prepared by H. S. Jackson, were published in the *Proceedings of the Indiana Academy of Sciences* for 1920.

Cryptogamic diseases of cacao and of cocoanut, over 20 in number, are discussed at length by R. Averna-Saccá in the Agricultural Bulletin of San Paulo for 1920. Forty-one figures accompany the 140 pages of text.

An illustrated article by C. E. Chidsey in the *Scientific American Monthly* for November, 1920, attempts to explain the formation of knots and boles on forest trees. This article might be interesting in connection with some of the recent experiments on plant cankers.

In a paper on two new *Sclerotinia* diseases found in Washington, by B. F. Dana in *Phytopathology* for May, 1921, *Sclerotinia gregaria* and *S. demissa* are described as new. The former occurs on the leaves and fruits of *Amelanchier Cusickii* and the latter on the leaves, twigs, and fruits of *Prunus demissa*.

Kauffman's paper on the species of *Inocybe* in Peck's collections, published in the Report of the State Botanist for 1919, contains many interesting notes and comments which are especially valuable because the author has recently completed a study of this difficult genus for *North American Flora,* which is expected to appear during the present year.

Another paper on new or little-known hosts for wood-destroying fungi, by Arthur S. Rhoads, appeared in *Phytopathology* for August, 1921. Quite an array of interesting hosts are noted for many of our common species; and additions both to hosts and descriptive characters are made in the case of *Polyporus cutifractus* Murrill and *P. carbonarius* Murrill.

A circular leaf-spot of geranium plants, caused by *Cercospora Brunkii,* is discussed by Garman in Bulletin 239 of the Maryland Experiment Station. Methods of watering, rather than mites and other insects, seem to spread the disease, which may be controlled by good ventilation, precautions against excessive humidity, and the use of Bordeaux mixture.

For two years there has been an exhibit of the oriental diseases of the Para rubber-tree, *Hevea brasiliensis,* at the Imperial College of Science and Technology in London. The chief fungous diseases represented are those caused by *Fomes lignosus, Fomes pseudoferreus, Ustulina zonata, Phytophthora Faberi, Corticium salmonicolor, Cyphella Heveae,* and *Botryodiplodia Theobromae.* The specimens were shipped from Ceylon and Malaya under the direction of J. B. Farmer.

The Tuckahoe, or *Pachyma cocos,* was illustrated and described at some length in the *Missouri Botanical Garden Bulletin* for June, 1921. This fungous sclerotium was not used for food to any great extent, if at all, by the Indians, because it has little nutritive value; the word tuckahoe was simply a general term applied to any edible root. Various medicinal properties have been ascribed to *Pachyma cocos,* but there seems to be no real foundation for the traditional belief in its curative virtues.

The following note regarding Krieger's remarks on *Amanita pantherina,* recently published in MYCOLOGIA, has been sent me by Neuhoff. According to him, *A. pantherina* DC. is undoubtedly poisonous, and is so considered by practically all mycologists everywhere; but in Germany it has been confused by Michael with the non-poisonous species, *A. spissa* Fries, and this error has been widely disseminated. Several authors are quoted by Neuhoff to support his opinion, among them Ricken, Romell, and Kauffman.

I have been endeavoring for some time to locate the original collector of *Ganoderma oregonense,* published in 1908 in *North American Flora.* The following extract from a letter received from Prof. Kirkwood seems to supply the missing information: "I think that the collection of fungi to which you refer was one that I made in the summer of 1905, along the Tillamook coast. I remember having packed a box which I sent to you along about August of that year, or maybe in September. I kept no record of them, but think there was a *Ganoderma* in the lot."

Philippine polypores were discussed by Graff in the *Torrey Bulletin* for last November. He uses *Polyporus Mariannus* Pers. for *P. anebus* Berk.; *P. rhodophoeus* Lév. for *Fomes semilaccatus* Berk.; *Ganoderma leptopum* (Pers.) Graff for *G. umbraculum* Pat.; *Fomes lineatus* (Pers.) Graff for *P. fastuosus* Lév.; and *Fomes roseo-albus* (Jungh.) Bres. for *P. caliginosus* Berk. The following species of Murrill are reduced to synonymy: *Ganoderma Curranii* equals *G. leptopum; Pyropolyporus Williamsii* equals

Fomes lamaensis; and *Coriolopsis Copelandii* equals *Fomes roseo-albus.* The author reports a very extensive and rich fungous flora, with much still to be learned.

In an article by Schmitz and Zeller on the effect of creosote on wood-destroying fungi, published in the *Journal of Industrial and Engineering Chemistry,* it is stated that the results of experiments indicate no toxic effects of any single distilled fraction or combination of fractions of the coal-tar creosote below a concentration of 1 per cent, calculated on the weight of air-dried sawdust. That is, there was no visible cessation of growth of either *Lenzites saepiaria* or *Polyporus lucidus* below a 1 per cent concentration. In a majority of cases the toxic point, which is defined as the minimum percentage of the creosote which will completely inhibit the growth of the organisms, lies between 2 and 4 per cent.

A splendid illustrated paper on "The Collybias of North Carolina," by Coker and Beardslee, appeared in the *Journal of the Elisha Mitchell Scientific Society* for December, 1921. Twenty-two species are recognized for the state, one of them, *Collybia lilacina,* being described as new. This species seems fairly abundant about Chapel Hill, and Dr. Coker has illustrated it both in color and in black and white. Our American *C. butyracea* is shown to be for the most part simply a large form of *C. dryophila;* and *C. subdryophila,* described by Atkinson from specimens collected in North Carolina by Coker, is considered a synonym of *C. dryophila.* The authors make *C. strictipes* Peck equivalent to *C. nummularia* Fries and *Mycena palustris* (Peck) Sacc. a synonym of *C. clusilis.* They also discuss the relationship of *C. tuberosa* and *C. cirrata;* and include *C. conigena* Fries, *C. hariolorum* Fries, *C. semitalis* Fries, and *C. distorta* A. & S. as good American species.

Dr. B. M. Duggar writes me that my report of his paper at the Toronto meeting, published on page 51 of the January number of *Mycologia,* is not in accordance with what he meant to convey. "I

did make a statement," he says, "to this effect: 'The term agency rather than organism is employed because it is hoped to avoid any possible prejudice to the direction in which such research may lead. It is distinctly felt that any assumption tacitly ascribing such diseases, because infectious, to organisms of the known or usual types may serve in the end to restrict rather than broaden the investigation.' Moreover, because I was able to determine more or less definitely the dimensions of the infectious agency I did not state as quoted that 'therefore,' it 'can not be a germ or similar organism.' Finally, I do not term it a 'living fluid contagion,' but did merely quote from Beijerinck his well-known expression, 'contagium vivum fluidum.'" Fortunately, Dr. Duggar's paper will shortly be published in full and those interested in the subject will at once forget my inaccurate report of it.

Enzyme action in *P. volvatus* and *F. igniarius* is discussed by Schmitz in the *Journal of General Physiology* for July, 1921. From the standpoint of parasitism, *Polyporus volvatus* is one of the most interesting of the wood-destroying fungi. Although no inoculation experiments have been made, numerous observations tend to confirm the opinion of the writer that it is truly parasitic. Throughout Washington, Oregon, and Idaho it is not at all unusual to find fruiting bodies appearing in great numbers over practically the entire surface of the trunk of Douglas fir, white fir, and western hemlock. This condition may be observed on trees still having a green, healthy foliage as well as on trees which to all appearances have been killed by the fungus.

Cultures of *Polyporus volvatus* and *Fomes igniarius* were obtained from the young sporophores by the tissue method. In *D. volvatus* the presence of the following enzymes was demonstrated: esterase, maltase, lactase, sucrase, raffinase, diastase, inulase, cellulase, hemicellulase, glucosidase, rennet, and catalase. In *F. igniarius* the presence of the following enzymes was demonstrated: esterase, maltase, lactase, sucrase, raffinase, diastase, inulase, cellulase, hemicellulase, glucosidase, urease, rennet, and catalase.

A NEW LICHEN FROM AN UNUSUAL SUBSTRATUM

Dung of various animals is examined frequently by mycologists for fungi not found elsewhere, and algae and mosses are seen on these substrata not infrequently. Among the fungi the lichenist sometimes sees *Cladoniae* and *Bacidia inundata,* but I had not until recently known of a lichen species found on no other substratum than dung.

For many years I have made it a practice to examine any dung that was colored green by algae or by moss protonemata, in the hope that I might find some new or rare lichen. Finally, on the tenth of March, 1920, near Conway, Rockcastle County, in central Kentucky, I found what appeared to be the minute fruits of some lichen which had parasitized *Protococcus* growing over some cow dung. These minute fruits were *Botrydium*-like in appearance, and examination showed that they belonged to a lichen of the genus *Thelocarpon.*

Growing with the *Thelocarpon* was another ascomycete with even more minute fruits, often giving the appearance of having parasitized the algae, forming a true lichen thallus. The *Thelocarpon,* on the other hand, showed no superficial thallus and no relationship with the algae other than that the fruits were rendered yellow-green by a layer of the algae, which spread over their surfaces. This condition made it appear that the lichen thallus was wholly within the substratum at the time when the fruits were mature, though algae were in all probability parasitized and a superficial thallus produced in early development, only to disappear later. Several species of *Thelocarpon* have been described as having no thalli, all of them probably having, in their early stages of development, superficial thalli of one of the types found among crustose lichens. In all of these instances it would be worth while to trace out the relationship between the lichen and the algae, which occur always in the thalloid veils of species of *Thelocarpon,* and usually in crustose thalli as well.

The description below was prepared after a careful examination of the descriptions of the 30 known species of the genus.

Thelocarpon fimicola Fink sp. nov.

Superficial thallus absent, or not readily distinguishable from the layer of algae growing over the surface of the substratum; apothecia minute and spheroidal, 0.05 to 0.15 mm. in diameter, pale within and surrounded by a thin thalloid veil; asci at first cylindrical, but becoming variously ventricose as the spores mature, most commonly distended toward the center and tapering toward both ends; paraphyses inconspicuous and disappearing as the fruit matures; spores one-celled, minute, hyaline, spheroidal to oblong, 2 to 4 by 1.5 to 2 mic., very numerous in each ascus.

Growing with algae on cow dung, in a damp wood, near Conway, Rockcastle County, Kentucky. The algae which were growing on the substratum gave it a coloration which could be detected from a standing position, but there is little evidence of the presence of algae in the dried specimens.

BRUCE FINK

ANOTHER GREEN-SPORED GENUS OF GILL-FUNGI

While working over specimens of *Pilosace* for the article on dark-spored agarics, published earlier in this number, I discovered some interesting things which did not properly belong under that title, so I have set them apart here.

Chlorophyllum Mass., based on the plant known as *Lepiota Morgani,* was published in 1898 and discussed in N. Am. Flora **10**: 64. 1914. It differs from *Lepiota* in having green spores.

Chloroneuron Murrill, based on the tropical American species, *Neurophyllum viride* Pat., was published in Mycologia **3**: 25. 1911 and discussed in N. Am. Flora **9**: 172. 1910. The spores are green and the lamellae fold-like, as in *Chanterel.*

In the new genus here described the spores are green and the lamellae adnate or adnexed, as in *Hypholoma* or *Psathyra. Schulzeria* Bres. is a "*Lepiota* without an annulus," having free gills and hyaline spores. Massee's *S. Eyrei,* however, has green spores and an appendiculate veil, with free gills.

Chlorosperma gen. nov.

Hymenophore putrescent, solitary to subcespitose; pileus fleshy,

glabrous or finely floccose; lamellae adnate or adnexed, often seceding at an early stage so as to appear free; spores smooth, green; stipe central, cartilaginous; veil, if present, not forming an annulus.

The type of this genus is *Agaricus olivaesporus* Ellis & Ev., described below.

Chlorosperma olivaespora (Ellis & Ev.) comb. nov.

Agaricus eximius Peck, Ann. Rep. N. Y. State Mus. 24: 70. 1872; not *A. eximius* C. P. Laest. Lapp. Torn. 1860.
Agaricus olivaesporus Ellis & Ev. Jour. Myc. 5: 27. 1889.
Hypholoma vinosum Kauffm. Agar. Mich. 1: 261. 1918.
Pilosace Peckii House, Bull. N. Y. State Mus. 205–206: 39. 1919.

Pileus thin, fleshy, fragile, convex or campanulate to expanded, subumbonate, solitary to subcespitose, 1–2 cm. broad; surface smooth or obscurely rugulose, pulverulent-floccose, becoming nearly glabrous, dark-brick-colored when moist, purplish-umber when dry, at length dark-sooty-brown; margin appendiculate at first with pale fragments of the veil; context thin, dingy-white, fragile, with very sweet odor and taste; lamellae adnate, seceding, crowded, rather broad, rounded behind, nearly plane to ventricose, entire on the edges, purplish-violet or purplish-brown to chestnut-brown, becoming lighter when dry and more or less tinged with brick-red; spores ellipsoid, smooth, olive-brown when fresh, umber-brown on drying, olivaceous under the microscope, about $5 \times 3\ \mu$; cystidia none; stipe slender, equal, colored and clothed like the pileus, cartilaginous, fistulose, rather brittle, exuding a slight purplish juice when broken, 2–4 cm. long, 1–2 mm. thick.

TYPE LOCALITY: Newfield, New Jersey.

HABITAT: On much-decayed wood, stumps, or logs in mixed woods, or among moss in swamps.

DISTRIBUTION: Rare in New York, New Jersey, Pennsylvania, Ohio, and Michigan.

ILLUSTRATION: Hard, Mushr. *f. 259*.

EXSICCATI: Ellis & Ev. N. Am. Fungi *2009*.

Peck's type specimens were collected on old stumps in woods at Greig, New York, in August, 1870. The sheet containing these has others from Old Forge, Indian Lake, and Felt House, with a drawing in color. Peck describes the gills as reddish, and later

applies this term to the spores, which was probably an error on his part. Because of this some have claimed that the species should be transferred to *Pluteus*. Hard says that he found the plant on three different occasions in Haynes' Hollow growing on old stumps and decayed logs. His figure is from a photograph of some of his plants taken by Kellerman and his description from Peck, no reference being made to the color of the spores.

Ellis found his plants among moss in swamps at Newfield, New Jersey, in sufficient quantity for distribution. An original packet in his herbarium is marked "July 30, 1887. Spores ellipsoid, 3.5–4 x 2 μ, olive-brown." In his description, he says the green shade is very distinct. He agrees with Peck in calling the lamellae "free."

Kauffman's specimens, some of which I saw at Albany, came from Bay View, New Richmond, Michigan, on much-decayed wood or logs in mixed woods. According to him the lamellae are adnate at first, then seceding; and the spores purplish-brown in mass, pale under the microscope. I find them to be identical with those from specimens collected by Peck and Ellis. Mrs. Delafield got a cluster of three hymenophores at Buck Hill Falls, Pennsylvania, last July and made a colored sketch of it. She found the "lamellae free or slightly adnate, separating readily from the stipe; odor very sweet, taste sweet."

The differences in the color of the spores recorded above are doubtless due to observations made on fresh and dried spores in mass by reflected light and under a microscope by transmitted light varying in intensity.

W. A. MURRILL

MYCOLOGIA

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RELIQUIAE FARLOWIANAE

DISTRIBUTED FROM THE FARLOW HERBARIUM OF HARVARD UNIVERSITY

ROLAND THAXTER

During a considerable period of years Dr. Farlow had been in the habit of setting aside from time to time, with a view to distribution for exchange, sets of New England Mosses, Hepatics, Lichens, and especially Fungi, of which somewhat over six centuries had accumulated at the time of his death. These had been largely collected and determined by himself, although a considerable number were contributed by other persons, especially by Mr. A. P. D. Piguet and Mr. A. B. Seymour. The Herbarium is now sending these sets to various botanical establishments in this country and in Europe, for purposes of exchange, and it has seemed desirable to publish this note concerning them as a matter of record and for the reason that, in a few instances, the names employed are new combinations or need some brief comment.

Each set comprises sixty decades, of which the first forty-five include only Fungi; while of those remaining, four decades are Lichens, five are Hepaticae, and six Musci. A certain number of additional specimens are also included in these sets, illustrating variations in hosts, imperfect conditions, etc., so that in all, each contains six hundred and ninety-three specimens. It may be mentioned in this connection that it is the intention of the Herbarium to send out, as they become available, in decades or in fascicles, further specimens, especially of the rarer Fungi, and including exotic as well as American species.

[MYCOLOGIA for March (14: 55–98) was issued April 12, 1922]

The task of sorting, preparing, and labeling approximately twenty-five thousand specimens for this distribution has been considerable, and the Herbarium is under great obligations to Mr. Seymour, Mr. Piguet, and Miss Nickerson, of the Herbarium Staff, for the great amount of careful and painstaking work which has been necessary. Mr. Seymour has himself printed and revised the labels, an undertaking which of itself has been laborious, exacting, and time-consuming, and in his case to a large extent a labor of love for the purpose of forwarding the accomplishment of Dr. Farlow's original intentions.

The determinations of the species included in this set are almost wholly those made by Dr. Farlow, either personally or after submission to other experts, and in only a few instances has it been thought desirable to make slight changes, since the extent to which they represent his expert opinion as to identities forms perhaps the most important element of its value. It should be remembered, nevertheless, that some of these determinations may have been provisional in his mind, and subject to further verification or modification, had he been able to go over them for final revision before their distribution; and it is very probable that errors, which he would himself have corrected, may be thus perpetuated.

For the convenience of those who make a practice of binding their sets of exsiccati in preference to distributing them in the oubliette of a General Herbarium, title pages and lists of each of the six volumes have been printed and distributed with the sets.

No. 15. **Diatrypella ciliatula** (Fr.) Farlow, nov. comb.

The *Sphaeria ciliatula* of Fries,[1] placed in *Calosphaeria* by Karsten and represented in the Farlow Herbarium by various collections from New England and Europe, appears to be rightly included in *Diatrypella*.

No. 73. PLEOMASSARIA MAXIMA Ell. & Ev.

The melanconeaceous condition, *Sporidesmium Fusus* B. & C., is present in many of the specimens, some of which are over-mature. The material has been examined by Dr. Shear, who confirms the identity of this form with his *P. Magnoliae*.

[1] Syst. Myc. 2: 406. 1823.

No. 102, *a*, *b*, *c*. CENANGIUM BALSAMEUM Peck

The three specimens included comprise one ascigerous and two pycnidial stages, the latter *Gelatinosporium abietinum* Peck, formerly described as an imperfect stage of Peck's "var. *abietinum*" (Peck's Report 43: 86 (40), 1890). There seems to be no previous mention of its association with the type form.

No. 106. CENANGIUM TURGIDUM (Schw.) Fries

Mr. Seymour notes that, although this name is used in Dr. Farlow's label, the species seems to be a synonym of *Peziza quernea* Schw.[2] This, being the older specific name, should therefore have priority, and the species should thus bear the name **Cenangium querneum** (Schw.) Seymour.

No. 120. GLIOCLADIUM PENICILLIOIDES Corda

This genus of Plectascineae, which was inadvertently included among the Discomycetes in assembling the sets, is familiar to any one who has dealt with laboratory cultures; often producing its perithecia on dung and other substances. In nature it may be pseudohypogaeous, occurring on buried decaying roots, and in the present instance was found growing away from the light in a pile of old seaweed used for fertilizer. I am myself responsible for the conclusion that *Penicillium insigne* Bainier, *Licipenicillium insigne* Brefeld, and *Lilliputia Gaillardii* Boud. & Pat. are synonyms, and am under the impression that there are still others.

No. 121. GODRONIA NEMOPANTHIS (Peck) Sacc.

An erratum in this label is "conidia" for "pycnidia." There appears to be no previous reference to the association of this species with a Sphaeronema.

No. 122. **Godronia turbinata** (Schw.) Farlow, nov. comb.

This is transferred by Dr. Farlow from the genus *Tympanis*, in which it was originally placed by Schweinitz.[3] It is a conspicuous and characteristic form on *Diervilla Lonicera* Mill., and has been

[2] Schr. Nat. Ges. Leipsig 1: 124. 1822.
[3] Trans. Am. Phil. Soc. II. 4: 237. 1832.

collected at Chocorua, N. H., by Dr. Farlow, and in quantity by myself at Kittery Point, Maine.

No. 135, *a* and *b*. **Pezicula pruinosa** Farlow, nov. sp.

Cupulis cinnamomeis vel dilute vinaceo-cinnamomeis (Ridgway) sparsis vel seriatim erumpentibus, primum urceolatis vel subturbinatis, breve stipitatis, basi albopruinosis; denique expansis disco plano pallidiore, .5–1 mm. lato: ascis 8-sporis, 95–110 x 18–21 μ: sporidiis oblique monostichis vel subdistichis, hyalinis, continuis, subellipticis vel subcymbiformibus, inaequilateralibus, utrinque rotundatis, 22–25 x 8–9 μ: paraphysibus filiformibus, copiosis, simplicibus vel apice subramosis, 1 μ diam.

Sharon and Cambridge, Mass.; Chocorua, N. H., on *Amelanchier.*

This is the perfect stage of the well-known and striking *Sphaeronema pruinosum* Pk.,[4] with which it is not uncommonly associated on *Amelanchier* in the vicinity of Cambridge, although this association does not seem to have been previously recorded.

No. 144. **Scleroderris Cephalanthi** (Schw.) Farlow, nov. comb.

This species, placed in *Peziza* by Schweinitz,[5] is here transferred for the first time by Dr. Farlow to *Scleroderris*.

No. 159. **Aposphaeria brunneotincta** Farlow, nov. sp.

Peritheciis majoribus, discretis vel subaggregatis, nigris vel nigrobrunneis, sphaericis vel irregularibus, siccatis saepe depressis vel collapsis, superficialibus vel basi insculptis, 250–500 μ diam., poro irregulari pertusis. Sporidiis minoribus 5–10 x 1.5–2.5 μ, cylindraceis, suballantoideis vel subfusiformibus, rectis vel curvulis, brunnescentibus; sporophoris brevibus, fasciculatis, ramosis suffultis.

On the inner surface and along the sutures of chestnut burs, *Castanea dentata* (Marsh.) Borkh., Sharon, Mass. April, 1908. A. P. D. Piguet.

According to Dr. Farlow's memorandum, this species occurs in the Curtis Herbarium, under *Sphaeria*, with this specific name. Although Dr. Farlow is responsible for this reference, it is with

[4] Ann. Rep. N. Y. State Mus. 24: 85. Jan. 1872.

[5] Schr. Nat. Ges. Leipsig 1: 123. 1822.

regret that I have felt obliged to be concerned in making an addition to so vague and uninteresting a genus.

No. 164, *a* and *b*. COSTANTINELLA CRISTATA Matruchot

As far as I am aware this is the first American record of this species. The Cambridge gathering (*164 a*) has been determined by myself and appears to correspond in all respects to the figures and description given by Matruchot of the type material, which he also found growing on dead leaves on the ground. Although he regards them as distinct, it seems not improbable that this species is not different from Bonorden's *Verticillium pyramidale,* with which it corresponds very closely in appearance, even to the peculiar sterile terminations of the main sporophores. The peculiar character on which the genus is based, namely, the crest-like origin of the spores on a curved "basidium," may well have escaped the notice of Bonorden, whose figures are manifestly diagrammatic.

It seems to me somewhat doubtful whether *No. 164 b,* which was regarded by Dr. Farlow as the same, should rightly be referred to this species. It occurs very commonly on rotten logs and on the inner side of moist loose bark. It forms a much thinner growth, without the cottony character of the type, and is a smaller plant. Although it has the same crest-like type of sporulation, it seems to lack the conspicuous and well-differentiated sterile terminations of the main sporophores above alluded to. Though a *Costantinella,* I should therefore feel some hesitation in regarding the two as belonging to a single species.

No. 460. **Calicium Rhois** (B. & C.) Farlow, nov. comb.

This is the *Stilbum Rhois* B. & C.[6] of the Curtis Herbarium. Whether the smaller *Calicium Curtisii* of Tuckerman should be regarded as distinct, I do not feel competent to judge.

No. 542. SPHAGNUM CUSPIDATUM Ehr. var.

Dr. A. LeRoy Andrews informs me that the form distributed is regarded as a distinct species under the name *S. Torreyanum* Sulliv.

HARVARD UNIVERSITY,
CAMBRIDGE, MASSACHUSETTS.

[6] Grevillea 3: 64. 1874.

NEW OR NOTEWORTHY RUSTS ON CARDUACEAE[1]

H. S. Jackson

In connection with a study of the species of *Puccinia* occurring on Carduaceae, which the writer has been making while preparing the manuscript of this group for the rust portion (Vol. 7) of the *North American Flora,* a number of undescribed species have come to light and certain interesting situations encountered.

The original plan to include such material in a series of papers dealing with the species on Carduaceae from all parts of the world[2] has not been abandoned, but owing to the difficulty of obtaining material of all the extra-limital species, and the prospect of early publication of the remaining numbers of the rust portion of the *North American Flora,* it has seemed best to record the following species and notes at this time.

Puccinia clara nom. nov.

Puccinia hyalina Jackson, Bot. Gaz. 55: 298. 1918. Not *P. hyalina* Dietel, 1905.

In 1918 the writer used the name *Puccinia hyalina* for a species on *Vernonia scariosa* Arn. from Ceylon. The above name is now offered as a substitute, since it has been found that the earlier use of *P. hyalina* by Dietel (cf. Engl. Bot. Jahrb. 37: 99. 1905) for a Japanese *Carex* rust had been overlooked.

Puccinia Tonduziana Speg. Bol. Acad. Nac. Ci. Cordoba 23: 184. 1919

This species was described from material collected by A. Tonduz, September, 1896, on an unknown arborescent composite, near San Francisco, Costa Rica.

[1] Contribution from the Botanical Department of the Purdue University Agricultural Experiment Station.

[2] Cf. H. S. Jackson, Carduaceous Species of *Puccinia.*—I. Species occurring on the tribe Vernonieae. Bot. Gaz. 55: 289–312. 1918.

A specimen of the original collection, received some time ago by Dr. Arthur from Spegazzini, has been carefully studied and it is evident that the species is identical with *Puccinia praealta* Jackson & Holway (cf. Jackson, Bot. Gaz. **55**: 306. 1918). The latter was described from several collections on *Vernonia trifloscu-losa* H.B.K. made by E. W. D. Holway in Guatemala and Costa Rica. A comparison of the host of *P. Tonduziana* with *P. prae-alta* leaves little doubt that they are the same.

Spegazzini, presumably on account of the character of the sorus, mistook the colorless uredospores for aeciospores, and described aecia and telia only for the species. His specimens are considerably older than most of the Holway collections and show some sori on the under surface of the leaves, while many of the epiphyllous sori are empty and their deep-seated origin is not as evident.

PUCCINIA SUBDECORA Sydow & Holway; Sydow, Ann. Myc. **1**: 17. 1903

With this *Puccinia*, which occurs in the west on *Coleosanthus grandiflorus* (Hook.) Kuntze, an *Aecidium* is sometimes associated, and for a time it was thought that it was a long-cycled *aut-eu-Puccinia*. When the final study of this species was made, however, the writer became convinced that the aecia belonged to a heteroecious rust, on account of the fact that no uredinia developed in certain collections on which the aecia were well past maturity, and because of differences in distribution. Ten aecial collections are in the Arthur herbarium from Colorado, Arizona, and New Mexico, while only five uredinial or telial collections have been made in Colorado and Utah.

A careful search was therefore made for evidence as to the type of life history of this species. A. O. Garrett made a uredinial collection of this species June 22, 1905, at Mill Creek Canyon, Salt Lake County, Utah. The sori in this collection are confined to the stems of young shoots and occur just below the surface of the ground. A careful study of this collection has revealed the presence of a few pycnia associated with these uredinia, indicating that this species is a brachy-form referable to the genus *Bullaria* of the Arthurian classification. With reference to this collection Mr.

Garrett wrote (in litt. Jan. 21, 1919): "I pulled up some of the plants of the *Coleosanthus* for another purpose and noticed the sori on the stems next the roots and entirely invisible from the surface of the ground." This observation, together with the finding of pycnia on the collection referred to, suggests that the life history of many more species of *Puccinia* could be determined if collections could be made early in the season as the plants are coming through the ground.

The aecia mentioned above have since been described as *Aecidium arcularium* Arth. (cf. Bull. Torrey Club 47: 478. 1920).

PUCCINIA KUHNIAE Schw.

A careful study of the common rust on Kuhnia in comparison with the species on closely related hosts has resulted in the conviction that *Puccinia Brickelliae* Pk. and *P. Barroetiae* Syd. should be considered synonymous with *P. Kuhniae*. The hosts of the three species are very closely related and there is no essential difference between the rusts. The determination of the life history of this species as a *brachy-Puccinia* is based entirely on cultures made by Dr. Arthur (cf. Jour. Myc. 12: 23. 1906 and Mycologia 1: 233. 1909), no field collections of pycnia associated with uredinia having been made.

The type locality for this species was recorded by Schweinitz as Bethlehem, Pennsylvania. Since this is a western rust, the most eastern locality of any recent collection being in Indiana, there is some doubt whether the type collection is from Pennsylvania as stated. It is possible that Schweinitz made this collection in Indiana, as it is known that at one time he traveled as far west as Hope, Indiana.

The synonymy, etc., of the species, according to this interpretation, is as follows:

PUCCINIA KUHNIAE Schw. Trans. Am. Phil. Soc. II 4: 296. 1832

Puccinia Brickelliae Peck, Bull. Torrey Club 12: 34. 1885.
Dicaeoma Brickelliae Kuntze, Rev. Gen. 3^3: 468. 1898.
Dicaeoma Kuhniae Kuntze, Rev. Gen. 3^3: 469. 1898.
Puccinia Barroetiae Sydow, Monog. Ured. 1: 28. 1902.
Bullaria Kuhniae Kern, Trans. Am. Microsp. Soc. 32: 65. 1913.

ON CARDUACEAE [EUPATORIEAE]:

Barroetia sp., *Coleosanthus* (*Brickellia*) sp., *Kuhnia* sp.

TYPE LOCALITY: "Bethlehem, Pennsylvania," on *Kuhnia* sp., probably error for Indiana.

DISTRIBUTION: Indiana to Montana and Arizona, south to Texas and southern Mexico.

Puccinia redempta sp. nov.

O. Pycnia unknown.

II. Uredinia hypophyllous, scattered or sometimes crowded and more or less confluent, roundish or elliptic, 0.5–1 mm. across, tardily naked, pulverulent, chestnut-brown, ruptured epidermis cinereous, conspicuous; urediniospores globoid or ellipsoid, somewhat irregular, 23–27 by 26–32 μ; wall dark cinnamon-brown, 1.5–2 μ thick, moderately echinulate, the pores 2, approximately equatorial.

III. Telia hypophyllous, scattered, roundish, 0.5–0.8 mm. across, tardily naked, pulverulent, chocolate-brown, ruptured epidermis cinereous, conspicuous; teliospores ellipsoid, somewhat irregular, 30–35 by 43–58 μ, rounded at both ends, slightly constricted at septum; wall chestnut-brown, 3–4 μ thick, slightly thickened at apex, 5–7 μ, concolorous or slightly lighter in color at apex, smooth; pedicel colorless, flexuous, short, deciduous or equalling the spore, often attached obliquely.

ON CARDUACEAE [EUPATORIEAE]:

Eupatorium atriplicifolium Lam., on bank, Road from town to Highbush, Tortola, West Indies, Feb. 13–17, 1913, N. L. Britton and J. A. Shafer, phan. spec. no. *795* (type).

The specimen on which this species is based is fairly ample and was obtained from a specimen in the phanerogamic herbarium at the New York Botanical Garden by the writer in 1917.

It belongs to the smooth-spored group of *Eupatorium* Puccinias and is apparently most closely related to *P. pachyspora* Diet. and *P. Eupatorii* Diet., differing from them both in the slightly thickened apex and from *P. Eupatorii* in the much broader spores. The urediniospores are not compressed laterally as in *P. pachyspora* and *P. Kuhniae* Schw.

PUCCINIA TOLIMENSIS Mayor, Mem. Soc. Neuch. Sci. Nat. 5: 516. 1913

This species of *micro-Puccinia* was described from a single collection made by E. Mayor on *Eupatorium* sp., near Soledad in the Central Andes, Department of Tolima, Colombia, Oct. 6, 1910 [No. *64*]. Three collections were made by E. W. D. Holway in Guatemala, one on *Eupatorium pansamalense* Robinson (Holway *802*) and two on *Eupatorium* sp. indet. (Holway *22,806*).

On July 22, 1917, a collection of a short-cycled *Puccinia* was made by the writer, in company with H. H. Whetzel and E. F. Hopkins, on *Eupatorium urticaefolium* Reichard, in Bergen swamp, Genessee County, New York. After careful study it has been decided to assign this collection to the above-named species. The distribution, from central New York to Colombia, South America, in isolated localities, suggests that it should be found also in other places.

Puccinia Parthenices sp. nov.

II. Uredinia not seen; urediniospores in the telia obovate or ellipsoid, 16–23 by 24–26 μ, slightly flattened laterally; wall light cinnamon-brown, 1.5–2.5 μ thick, very finely and closely echinulate, appearing smooth when wet, the pores 2, equatorial.

III. Telia hypophyllous, rarely epiphyllous, round, 0.4–0.8 mm. across, early naked, compact, pulvinate, blackish-brown, ruptured epidermis not conspicuous; teliospores obovate, oblong or ellipsoid, 20–26 by 32–45 μ, rounded or obtuse above, rounded below, slightly constricted at septum; wall light chestnut-brown, 1.5–2.5 μ thick, apex thickened 7–9 μ by a broad semi-hyaline umbo, similarly thickened over pore or lower cell at septum, smooth; pedicel colorless, firm, once to thrice length of spore.

ON CARDUACEAE [HELIANTHEAE]:

Parthenice mollis A. Gray, Ft. Lowell, Arizona, Oct. 24, 1903, J. J. Thornber *1029*, comm. L. N. Goodding (type); Baboquivari Mts., Arizona, Oct. 24, 1919, L. N. Goodding *43*.

This species was separated from specimens in the Arthur herbarium tentatively assigned to *P. Parthenii* Arth. It differs from that species as now interpreted in both urediniospore and teliospore characters. The urediniospores in *P. Parthenii* are globoid or ellipsoid, 20–23 by 23–32 μ, with walls 3–3.5 μ thick, and the teliospores are ellipsoid, 28–32 by 38–48 μ, with walls 4–5 μ thick.

PUCCINIA PARTHENII Arth. Bull. Torrey Club 37: 570. 1910

This name was based on *Uredo Parthenii* Speg., which was described in 1899 from a uredo on *Parthenium Hysterophorus* L. Telia were found by Dr. Arthur on two collections on *P. argentatum* A. Gray made by F. E. Lloyd in Mexico. With these collections were included one uredinial collection on *P. Hysterophorus* from Mexico State (Holway *3228*) and one on *P. incanum* H.B.K. from Texas (Tracy & Earle *324a*).

A recent study made by the writer has led to the conclusion that two distinct species were probably included. The urediniospores of the collection on *P. Hysterophorus* are quite different from those on *P. argentatum*. On the former they are obovate or triangular, 20–24 by 24–28 μ, with walls 1.5–2.5 μ thick, minutely and sparsely echinulate, the pores 3, one in apex and two subequatorial, while on the latter they are globoid or ellipsoid, 20–23 by 23–32 μ, the walls 3–3.5 μ thick, finely and moderately echinulate, the pores 2 or 3, approximately equatorial.

Parthenium Hysterophorus, as noted above, is the type host for *Uredo Parthenii* Speg. Unfortunately this has not been seen, and it has not been possible to determine with certainty whether or not the uredinial collection made by Holway in Mexico is identical. It seems best, however, to exclude *Uredo Parthenii* Speg. from *Puccinia Parthenii* Arth. for the present and to tentatively assign to it the Mexican collection on *P. Hysterophorus*. The collection made by Lloyd at Mazapil, state of Zacatecas, Mexico, March 27, 1908, on *P. argentatum* should be taken as the type of *Puccinia Parthenii* Arth. as emended.

PUCCINIA ADDITICIA Jackson & Holway

This name was published by Dr. Arthur at our request as a substitute for the name *P. Coreopsidis* Jackson & Holway, which was based on a Guatemalan collection determined as on *Coreopsis mexicana* (DC.) Hemsl. It happened that the name *P. Coreopsidis* was used by Miss E. Wakefield for an entirely different rust (a *micro-Puccinia*) on *Coreopsis* from Uganda, tropical Africa, four months previously (cf. Bull. Misc. Inf. Kew **1918**: 209. Aug. 1918).

Recently the writer had occasion to compare *P. additicia* with

P. Electrae Dietel & Holway and found that the two species are identical. *P. Electrae* was based on a collection made by E. W. D. Holway in Oaxaca, Mexico, the host for which was determined as *Electra Galeottii* A. Gray. The genus *Electra* DC. 1836 (not *Electra* Noron., or *Electra* Panz.) is now considered identical with *Coreopsis*. Furthermore, S. F. Blake (Cont. Gray Herb. N. S. **52**: 55. 1917) has recently shown that *C. mexicana* and *Electra Galeottii* are both synonyms of *Coreopsis mutica* DC.

The following is the correct synonymy, etc., of the species:

PUCCINIA ELECTRAE Dietel & Holway; Holway, Bot. Gaz. **31**: 333. 1901

Puccinia Coreopsidis Jackson & Holway; Arth. Am. Jour. Bot. **5**: 536. Dec. 1918; not *P. Coreopsidis* Wakefield, Aug. 1918.

Puccinia additicia Jackson & Holway; Arth. Bull. Torrey Club **48**: 32. 1921.

ON CARDUACEAE [HELIANTHEAE]:

Coreopsis mutica DC. (*C. mexicana* Hemsl., *Electra Galeottii* A. Gray), Oaxaca and Guatemala.

TYPE LOCALITY: Oaxaca, Mexico, on *Electra Galeottii*.

DISTRIBUTION: Southern Mexico and Guatemala.

Puccinia turgidipes sp. nov.

II. Uredinia not seen; urediniospores in the telia, strongly compressed laterally, when viewed with pores in optical section, oblong, 16–18 by 26–29 μ, when in face view, subcircular, 24–27 by 26–29 μ; wall dark cinnamon-brown, 2.5–3 μ thick, moderately and prominently echinulate, the pores 2, opposite and equatorial.

III. Telia amphigenous, scattered, round, small, 0.2–0.5 mm. in diameter, early naked, becoming pulverulent, blackish-brown, ruptured epidermis not noticeable; teliospores globoid or broadly ellipsoid, 30–32 by 32–38 μ, rounded at both ends, not constricted at septum; wall chestnut-brown, 3–4 μ thick, thickened at apex to 6 μ, as well as over pore of lower cell near septum, smooth; pedicel colorless, once to twice length of spore, with thick walls above, becoming abruptly inflated, 12–24 μ from point of attachment.

ON CARDUACEAE [HELIANTHEAE]:

Viguiera deltoidea Parishii (Greene) Vasey & Rose, Estrella Mts. near Maricopa, Arizona, Oct. 30, 1919, L. N. Gooding *48*.

This species is easily distinguished from all other Carduaceous rusts, which we have studied, by the strongly compressed character of the urediniospores and the inflation of the pedicels of the teliospores when wet.

The host was determined by Dr. S. F. Blake.

Puccinia triannulata (Berk. & Curt.) comb. nov.

Uromyces triannulatus Berk. & Curt.; Berkeley, Grevillea 3: 56. 1874.

Puccinia mirifica Dietel & Holway; Dietel, Erythea 3: 79. 1895.

Caeomusus triannulatus Kuntze, Rev. Gen. 3^3: 451. 1898.

Dicaeoma triannulatum Arth. Résult Sci. Cong. Bot. Vienne 346. 1906.

Through the courtesy of Dr. R. Thaxter, I have had the opportunity of examining a fragment of the type of *Uromyces triannulatus* Berk. & Curt. from the Curtis Herbarium at Harvard University. A second fragment was obtained from the Kew Herbarium by Dr. J. C. Arthur. Both bear the same number, 2270. The specimen from the Curtis Herbarium is labeled as follows: "*Uredo triannulata* B. & C. on *Borrichia frutescens* Santee Canal (?) S. C., June 1848. Ravenel 758." The specimen from Kew is labeled, "*Uromyces triannulatus* B. & C. in *Borrichia frutescens* Car. Inf."

An examination of these specimens leaves no doubt that *Uromyces triannulatus* was based on the uredinial stage of the species later described as *Puccinia mirifica* Dietel & Holway and now known to occur on *B. frutescens* from South Carolina, Florida, and Texas, and on *B. arborescens* from Florida, the Bahamas, and Bermuda.

Pycnia occur with the uredinia in several collections, leaving no doubt that this is a true *brachy-Puccinia* referable to the genus *Bullaria* in the classification proposed by Dr. Arthur.

PUCCINIA BALSAMORRHIZAE Peck

When preparing the manuscript of this species for the *North American Flora,* two points of interest were noted which seem worthy of record at this time.

A comparison of the type with that of *P. Wyethiae* Peck re-

sulted in the conclusion that there was no essential difference between the two. *Balsamorrhiza* and *Wyethia*, the host genera of the two species, are very closely related, and the distribution of *P. Balsamorrhizae* includes that of *P. Wyethiae*.

The life history of this species has been unknown; no collections of aecia have ever been made to our knowledge on either host. In May, 1919, the writer made a collection of uredinia on young leaves of *Balsamorrhiza* sp. at The Dalles, Oregon, which, when studied, showed a few pycnia associated with the uredinia, which occurred in elongated groups along the petioles and the midribs of the leaves. The pycnia are few, gregarious, inconspicuous, orange-yellow, flask shaped, 70–100 by 100–130 μ, the ostiolar filaments projecting slightly. This indicates that the species is a *brachy-Puccinia* referable to the genus *Bullaria* of the classification proposed by Dr. Arthur.

Following is the full synonymy of this species as interpreted above:

PUCCINIA BALSAMORRHIZAE Peck, Bull. Torrey Club 11: 49. 1884

Trichobasis Balsamorrhizae Peck, Bot. Gaz. 6: 276. 1881.

Uredo Balsamorrhizae DeToni; Saccardo, Syll. Fung. 7: 842. 1882.

Trichobasis Wyethiae Peck, Bot. Gaz. 7: 45. 1882.

Puccinia Wyethiae Peck; Harkness, Bull. Cal. Acad. Sci. 2: 442. 1887.

Dicaeoma Balsamorrhizae Kuntze, Rev. Gen. 3^3: 468. 1898.

ON CARDUACEAE [HELIANTHEAE]:

Balsamorrhiza sp., *Wyethia* sp.

TYPE LOCALITY: [Salt Lake City], Utah, on *Balsamorrhiza macrophylla*.

DISTRIBUTION: Colorado, Utah, and Montana to British Columbia and California.

Puccinia vaga sp. nov.

II. Uredinia hypophyllous, becoming somewhat amphigenous, scattered, round, small, 0.2–0.4 mm. in diameter, early naked, pulverulent, cinnamon-brown, ruptured epidermis conspicuous; urediniospores globoid or broadly obovoid, 21–24 by 23–26 μ; wall

light cinnamon-brown, thin, 1–1.5 μ, moderately and prominently echinulate, the pores 2, opposite and equatorial.

III. Telia amphigenous, scattered, round, small, 0.2–0.5 mm. in diameter, early naked, pulvinate, becoming somewhat pulverulent, blackish-brown, ruptured epidermis evident; teliospores broadly or narrowly ellipsoid, 23–26 by 27–48 μ, rounded at both ends, slightly constricted at septum; wall reddish chocolate-brown, concolorous, medium-thick, 3–4 μ, slightly thicker above, 4–5 μ; pedicel colorless, about twice length of spore.

ON CARDUACEAE [HELIANTHEAE]:

Verbesina sp., Cuernavaca, Morelos, Mexico, Jan. 1908, E. W. D. Holway (type).

This species appears to differ sufficiently from other *Verbesina* rusts to warrant specific rank. It is perhaps most closely related to *Puccinia abrupta* Dietel and *P. Verbesinae* Schw. It differs from the former in the less thickened apex of the teliospores and in urediniospore characters. From the latter it differs in the concolorous teliospore wall and the thin-walled urediniospores.

The *Verbesina* rusts have proven to be a difficult group and further study based on more ample material will probably result in a realignment of some of the species. The following key will serve to indicate how the North American species have been separated for the *North American Flora*:

Telia only in the life history.	*P. ferox* D. & H.
Aecia or uredinia or both in life history.	
Teliospore-wall not over 7 μ thick at apex.	
Telia early naked.	
Teliospore-wall lighter at apex, uredinial wall 1.5–2 μ.	*P. Verbesinae* Schw.
Teliospore-wall concolorous, uredinial wall 1–1.5 μ.	*P. vaga* Jackson
Telia long covered by epidermis.	*P. irregularis* Dietel
Teliospore-wall more than 7 μ thick above.	
Teliospores typically rounded below.	*P. abrupta* Dietel
Teliospores typically narrowed below.	
Teliospore-wall laminate.	*P. invelata* Jackson
Teliospore-wall not noticeably laminate.	*P. cognata* Sydow

COLEOSPORIUM ARNICALE Arth. and PUCCINIA NUDA Ellis & Ev.

Coleosporium Arnicale Arth., described in 1907, was based on a single collection made by W. N. Suksdorf in Falcon Valley, Wash-

ington, Oct. 30, 1901. The host was originally identified as *Arnica foliosa* Nutt., but interpreted by Arthur as *A. cana* Greene. No other collections of a *Coleosporium* on *Arnica* have since been received in this laboratory and there has been some doubt as to the validity of the species. A year or two ago the writer, while working in the mycological herbarium of the New York Botanical Garden, had occasion to examine the type specimen of *Puccinia nuda* Ellis & Ev. This was also described as occurring on *Arnica foliosa* and was collected by Suksdorf (No. 200) in the same locality July 30, 1885. On the herbarium sheet containing the specimen of *P. nuda* there is a second collection of rust on the same host made at the same place and date (Suksdorf, No. 199). Ellis at the time he studied these specimens evidently supposed that the latter collection bore the aecidium of *P. nuda*, since the manuscript sheet of the original description in Ellis's handwriting (pasted on the herbarium sheet with the specimens) included a description of the rust on this collection as an *Aecidium*. When he published *P. nuda*, however, Ellis omitted the aecial description or any mention of the second collection. An examination of this made recently shows that it is unquestionably the uredinia of a *Coleosporium* identical with the type of *C. Arnicale* Arth. and on the same host.

More recently the writer has had occasion to study in detail the type of *Puccinia nuda*. This species is also known only from the type locality and collection. A few days previously *Puccinia Hemizoniae* Ellis & Tracy had been studied and the close resemblance between the two species was at once noted. As a result of this study the conclusion was reached that they are identical, and that the host of *P. nuda* is probably not *Arnica*, but a species of *Madia, Hemizonia, Hemizonella,* or some close relative of these.

Puccinia Hemizoniae (including *P. Madiae* Sydow) occurs on the same group of hosts as *Coleosporium Madiae* Cooke, and on account of the conclusion just recorded with reference to the *Puccinia,* the possibility that *Coleosporium Arnicale* was identical with *C. Madiae* at once suggested itself.

A comparison of the two species has resulted in the conviction that the former should be considered a synonym of the latter, and

the host, which is identical with the host for *Puccinia nuda*, is probably also *Madia, Hemizonia, Hemizonella*, or some close relative.

The synonymy, etc., of the two species, according to the interpretation above, is as follows:

COLEOSPORIUM MADIAE Cooke, Grevillea 7: 107. 1879

Stichospora Madiae Sydow, Ann. Myc. 2: 30. 1904.
Coleosporium Arnicale Arth. N. Am. Flora 7: 94. 1907.

ON CARDUACEAE [HELIANTHEAE]:

Anisocarpua, Centromadia, Harpaecarpus, Hemizonia, Madaria, Madia, Zonanthemus.

TYPE LOCALITY: Sierra Nevada, California, on *Madia Nuttallii.*
DISTRIBUTION: British Columbia to central California.

PUCCINIA NUDA Ellis & Ev., Jour. Myc. 3: 57. 1887

Puccinia Hemizoniae Ellis & Tracy, Jour. Myc. 7: 43. 1891.
Puccinia Lagophyllae Dietel & Holway; Dietel, Erythea 1: 250. 1893.
Dicaeoma Hemizoniae Kuntze, Rev. Gen. 3^3: 469. 1898.
Dicaeoma nudum Kuntze, Rev. Gen. 3^3: 469. 1898.
Puccinia Madiae Sydow, Monog. Ured. 1: 121. 1902.

ON CARDUACEAE [HELIANTHEAE]:

Calycadenia, Hemizonia, Lagophylla, Madaria, Madia.

TYPE LOCALITY: Falcon Valley, Washington, on "*Arnica foliosa*"; error for *Madia* (?) sp.
DISTRIBUTION: Washington to central California; also in South America.

PUCCINIA MELAMPODII Dietel & Holway

A group of short-cycled species of *Puccinia* occurring in subtropical regions of North America on a number of Carduaceous hosts of the tribe Heliantheae have proven to be very puzzling. These include especially the following:

P. Melampodii Dietel & Holway, on *Melampodium divaricatum*, from Guatemala and Morelos.

P. Synedrellae P. Henn., on *Synedrella nodiflora*, from the West Indies and Panama; also in South America.

P. Zinniae Sydow, on *Zinnia tenuiflora*, from Jalisco.
P. Diaziana Arth., on *Ximenesia encelioides*, from Coahuila.
P. Tridacis Arth., on *Tridax procumbens*, from Cuba.
P. Eleutherantherae Diet., on *Eleutheranthera ruderalis*, from the West Indies and Panama; also in South America.
P. Tetranthi Sydow, on *Tetranthus hirsutus*, from Haiti.

It will be noted that each one is known in North America on a single host species, and all are on separate genera. To these should be added unnamed forms on *Parthenium Hysterophorus* from southern Texas and on *Spilanthes oleracea* from Martinique. The latter might possibly be properly referred to *Puccinia Spilanthicola* Mayor.

A careful comparison of these forms has failed to reveal any method by which they can be separated on a morphological basis and it has been decided to treat them as one species in the *North American Flora*. It is possible, indeed quite probable, that they are biologically distinct and may even have had, in part, an independent origin. It seems reasonable to suppose that collectively or independently they are correlated with one or more cyperaceous rusts occurring in the same region, which have aecia on these or related hosts, but the genetic connection of which has not yet been determined.

It should be pointed out that this species is very much like *P. Emiliae* P. Henn. (see p. 119), which occurs on members of the tribe Senecioneae with a similar distribution. It is also related to *Puccinia Silphii* Schw., which occurs on *Silphium* sp. in temperate regions, but which has somewhat narrower spores.

The synonymy, etc., is as follows:

PUCCINIA MELAMPODII Dietel & Holway; Holway, Bot. Gaz. 24: 32. 1897

Puccinia solida Berk. & Curt. Jour. Linn. Soc. 10: 356. 1869. Not *P. solida* Schw. 1839.
Puccinia Synedrellae Lagerh.; Sydow, Ured. *376*, hyponym. 1890.
Puccinia Synedrellae P. Henn. Hedwigia 37: 277. 1898.
Dicaeoma cubense Kuntze, Rev. Gen. 3^3: 466. 1898.
Dicaeoma Synedrellae Kuntze, Rev. Gen. 3^3: 470. 1898.

Puccinia Zinniae Sydow, Monog. Ured. **1**: 188. 1902.
Puccinia Diaziana Arth. Bot. Gaz. **40**: 203. 1905.
Puccinia Tridacis Arth. Bull. Torrey Club **33**: 516. 1906.
Dasyspora Syncdrellae Arth. Résult Sci. Congr. Bot. Vienne 347. 1906.
Puccinia Eleutheranthcrae Dietel, Ann. Myc. **7**: 354. 1909.
Puccinia Tetranthi Sydow, Ann. Myc. **17**: 33. 1919.
Micropuccinia Syncdrellae Arth. & Jackson; Arth. Bull. Torrey Club **48**: 41. 1921.

ON CARDUACEAE [HELIANTHEAE]:

Hosts as above.

TYPE LOCALITY: Cuernavaca, Mexico, on *Melampodium* [*divaricatum*].

DISTRIBUTION: Central Texas to Panama and the West Indies; also in South America.

Puccinia solida B. & C. is based on a collection by Charles Wright, 1856–1857, in "Cuba Orientale" on an unknown composite, now interpreted as *Eleutheranthera ruderalis*. *Dicaeoma cubense* is based on the same collection.

It is very probable that there are other forms in South America and possibly in similar regions in other parts of the world which should be included here. It has, however, been impossible, up to the present time, to bring together all the material which would be needed in making such a comprehensive study, and it should be recognized that the treatment as outlined above is tentative only.

Puccinia Flaveriae sp. nov.

O. Pycnia unknown, probably not formed.

III. Telia amphigenous or caulicolous, gregarious on discolored spots, or extending for considerable distances on stems, round. small, 0.2–0.5 mm. in diameter, tardily naked, chestnut-brown, pulvinate, the caulicolous sori long covered by the cinereous epidermis. ruptured epidermis of foliicolous sori conspicuous; teliospores irregularly ellipsoid, clavate or cylindric, 15–19 by 32–50 μ, often bent to one side, rounded, obtuse or more or less acute above. rounded or narrowed below, not constricted at septum; wall light cinnamon-brown, 1.5–2 μ thick, much thicker above, 5–10 μ, smooth; pedicel one half length of spore or shorter, firm, concolorous with base of spore.

ON CARDUACEAE [HELENIEAE]:

Flaveria campestris J. R. Johnston (*F. angustifolia* A. Gray), Manhattan, Kansas, Sept. 15, 1893, M. A. Carleton (type).

The collection on which this species is based has been included with *Puccinia Asteris* Duby in the Arthur Herbarium, but it does not seem to be that species, and an attempt to assign it elsewhere with any degree of certainty has not been successful. It appears to be a *Micropuccinia* and there are no species on related hosts with which this can be logically placed. It differs from *P. Actinellae* in the irregular lighter-colored spores borne in sori which arise just below the epidermis and remain long covered. It is most nearly like a collection on *Hymenopappus carolinensis* (Lam.) Porter, which has been assigned to *P. Grindeliae* Pk.

PUCCINIA MILLEFOLII Fuckel

This species is known from a few collections on *Achillea Millefolium* L. from California, Montana, and Oregon, and one on *A. lanulosa* Nutt. from New Mexico. A careful comparison of this species, using both American and European material, has failed to reveal any morphological basis for separating this from *P. conferta* Diet. & Holway, which occurs on various species of *Artemisia* from North Dakota to northern Texas and westward to Washington and northern California, also in Europe. The hosts are closely related and there seems no good reason for keeping them separate for purposes of the *North American Flora*.

The synonymy is as follows:

PUCCINIA MILLEFOLII Fuckel, Jahrb. Nass. Ver. Nat. **23–24**: 55. 1870

Puccinia conferta Dietel & Holway; Dietel, Erythea **1**: 250. 1893.

Puccinia recondita Dietel & Holway; Dietel, Erythea **2**: 128. 1894. Not *P. recondita* Rob. 1857.

Puccinia artemisiicola Sydow, Monog. Ured. **1**: 14. 1902.

Dasyspora conferta Arth. Résult Sci. Congr. Bot. Vienne 346. 1906.

Dasyspora Millefolii Arth. Résult Sci. Congr. Bot. Vienne 347. 1906.

Micropuccinia conferta Arth. & Jackson; Arth. Bull. Torrey Club 48: 40. 1921.

Micropuccinia Millefolii Arth. & Jackson; Arth. Bull. Torrey Club 48: 41. 1921.

PUCCINIA EMILIAE P. Henn. Hedwigia 37: 278. 1898

Puccinia Emiliae, a typical *micro-Puccinia,* is based on a collection made by Dr. J. Urban in Jamaica on *Emilia sagittata* (Vahl) DC. It is also known on *E. sonchifolia* (L.) DC. and *Neurolaena lobata* (L.) R. Br., having a distribution from southern Florida, Panama, and the West Indies.

In 1907, Rev. J. M. Bates collected at Red Cloud, Nebraska, a short-cycled Puccinia on the cultivated *Calendula officinalis* L. and *Dimorphotheca cuneata* DC. This rust has since been collected on the former host at Guanabaroa, Cuba, by J. R. Johnston; Urbana, Illinois, by H. W. Anderson, and at New Castle, Indiana, by H. F. Dietz. The last collection was found on plants grown in the greenhouse, the others being garden collections. The rust had been tentatively assigned to *Puccinia recedens* Syd. in the Arthur Herbarium and the collection on *Dimorphotheca* was issued under that name in Bartholomew's North American Uredinales *1863*.

Recently, while studying the short-cycled Puccinias of this group, the writer found that, while there was some variation in the collections on different hosts, there was no sharp distinction between *P. Emiliae* and *P. recedens.* The latter has slightly shorter spores with somewhat thicker walls than the former.

Puccinia recedens, however, is a northern rust occurring on *Senecio* species and having a range extending from southern New York to West Virginia along the Atlantic coast and across the continent to the mountains of Oregon and Alberta. This species is interpreted, on account of the morphology of the teliospores and host relationships, as a correlated species with *Puccinia* (*Dicaeoma*) *Eriophorii* Thüm., which has aecia on *Senecio* and telia on *Eriophorum* with a quite similar range in North America.

Puccinia Emiliae, on the other hand, is apparently native of subtropical regions. For these reasons it has been decided to keep the two species separate and to assign to *P. Emiliae* the collections

noted above on the cultivated hosts *Calendula* and *Dimorphotheca*. It is suggested that *P. Emiliae* is probably correlated with some species of subtropical cyperaceous *Puccinia* (several of which have been described), the aecial connection for which is as yet unknown.

The collections on *Dimorphotheca* and *Calendula* add another rust to the increasing list of diseases of floricultural crops, which may, under certain conditions, become of considerable economic importance. Since these hosts are annuals, propagated by seed only, it is not anticipated that the rust will prove as destructive as those occurring on hosts propagated by cuttings.

Uredo abdita sp. nov.

II. Uredinia obscured by dense tomentum of host, apparently amphigenous, round or oval, large, 0.5–1.5 mm. in diameter, early naked, very pulverulent, chestnut-brown, ruptured epidermis not conspicuous; urediniospores usually considerably flattened laterally, with pores in face view globoid or broadly ellipsoid, 26–29 by 26–32 μ, with pores in optical section oblong or narrowly ellipsoid, 20–24 by 26–32 μ; wall chestnut-brown, thick, 2.5–3 μ, moderately but very finely echinulate, appearing smooth when wet, the pores 2, superequatorial.

ON CARDUACEAE [SENECIONEAE]:

Senecio Cineraria DC. (cultivated), Catalina Island, California, Aug. 1912, E. Bethel (type).

This species differs in pore characters and markings of the urediniospores from other *Senecio* rusts which we have been able to obtain for examination.

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DARK-SPORED AGARICS—II

GOMPHIDIUS AND STROPHARIA

William A. Murrill

The first article of this series, published in Mycologia for March, 1922, dealt with the species of *Drosophila, Hypholoma,* and *Pilosace* occurring in the temperate regions of eastern North America. I shall take up now two genera having an annulus, in addition to a fleshy stipe; and these may easily be distinguished by the following key:

Lamellae decurrent, waxy; veil glutinous; spores black.	*Gomphidius*
Lamellae adnate or adnexed; veil membranous; spores purplish-brown.	*Stropharia*

Gomphidius Fries, Gen. Hymen. 8. 1836

This genus is distinguished by its glutinous veil; decurrent, waxy lamellae; and black, elongate spores. There are very few species and these occur mostly in temperate regions. The single tropical species, *G. jamaicensis*, is known only from Cinchona, Jamaica, at an altitude of 1,500 meters. *G. vinicolor* occurs in California; *G. oregonensis* is abundant on the Pacific coast; and *G. tomentosus* is rare; the last two species being known only from the coastal region.

Pileus reddish-brown, not blackening; context yellow: stipe yellowish-brown.	1. *G. viscidus*
Pileus purplish-brown or yellowish-brown, often black-spotted, but not blackening entirely; context white; stipe whitish.	2. *G. glutinosus*
Pileus pale-brownish-red, becoming entirely black on drying; stipe white, becoming black.	3. *G. nigricans*
Pileus dark-red, becoming blackish on drying; stipe vinous-red.	4. *G vinicolor*
Pileus dull-brownish-pink, becoming black-spotted; stipe yellowish-brown.	5. *G maculatus*
Pileus dingy-pink; stipe pale-yellow.	6. *G. flavipes*
Pileus whitish, sometimes tinged with red, becoming blackish at times; stipe whitish.	7. *G. furcatus*

1. GOMPHIDIUS VISCIDUS (L.) Fries, Epicr. Myc. 319. 1838

Agaricus viscidus L. Sp. Pl. 1173. 1753.
Paxillus pubescens Ellis, Bull. Torrey Club **6**: 76. 1876.

Pileus fleshy, convex, umbonate, 3–8 cm. broad; surface smooth, viscid, reddish-brown, not blackening; context compact, yellow; lamellae much branched, long decurrent, especially with age, rather broad, subcrowded, reddish-brown, sometimes slightly blackened in old specimens; spores subcylindric to subfusiform, smooth, translucent, uniguttulate, brownish, 16–23 x 5–8 μ; stipe cylindric or tapering below, pale-brown with abundant yellowish-brown tomentum when young, rhubarb-colored within, solid, 4–5 cm. long, 4–10 mm. thick; veil not evident.

TYPE LOCALITY: Sweden.

HABITAT: On the ground in pine woods.

DISTRIBUTION: Eastern United States, New York to Alabama; also in Europe.

ILLUSTRATIONS: Hussey, Ill. Brit. Myc. **2**: *pl. 24;* Pat. Tab. Fung. **2**: *f. 656;* Richon & Roze, Atl. Champ. *pl. 23, f. 7–10;* Schaeff. Fung. Bavar. *pl. 55;* Sow. Engl. Fungi *pl. 105*.

2. GOMPHIDIUS GLUTINOSUS (Schaeff.) Fries, Gen. Hymen. 8. 1836

Agaricus glutinosus Schaeff. Fung. Bavar. Ind. 17. 1774.

Pileus fleshy, obtuse; 5–14 cm. broad; surface purplish-brown, often with black spots, sometimes yellowish-brown, never entirely blackening, glutinous; context white, soft, watery, with no distinctive odor; lamellae decurrent, forking, entire, easily separating, short, white to cinereous, sometimes dark-brown but not blackening, subcrowded, broad; spores dark-brown, smooth, fusiform, translucent, 17–23 x 4–6 μ; cystidia cylindric; stipe cylindric or larger below, viscid, whitish, due to the dense coat of appressed fibrils, 4–9 cm. long, 8–15 mm. thick; veil heavy, glutinous, leaving an evident annulus.

TYPE LOCALITY: Bavaria.

HABITAT: On the ground in coniferous woods.

DISTRIBUTION: Northeastern North America; also in Europe.

ILLUSTRATIONS: Richon & Roze, Atl. Champ. *pl. 23, f. 11–14;* Ricken, Blätterp. Deutschl. *pl. 3, f. 1;* Schaeff. Fung. Bavar. *pl. 36;* Sow. Engl. Fungi *pl. 7*.

3. GOMPHIDIUS NIGRICANS Peck, Ann. Rep. N. Y. State Mus. **48**: 110. 1897

Pileus convex or nearly plane, 2.5–5 cm. broad; surface pale-brownish-red, covered with a tough gluten which becomes black in drying; context firm, whitish; lamellae distant, decurrent, some of them forked, white, becoming smoky-brown, black in the dried plant; spores oblong-fusoid, 15–25 x 6–7.5 μ; stipe subequal, longer than the diameter of the pileus, glutinous, solid, at first whitish, especially at the top, soon blackish by the drying of the gluten, whitish within, slightly tinged with red toward the base, 3.5–6 cm. long, 4–8 mm. thick.

TYPE LOCALITY: Westport, New York.

HABITAT: Under pine trees.

DISTRIBUTION: New England to Tennessee; also in Europe.

ILLUSTRATION: Atk. Stud. Am. Fungi *f. 50, 51.*

Good specimens are at Albany, attached to a herbarium sheet. According to Peck, the entire plant is black when dry because of a blackening gluten which covers it.

4. GOMPHIDIUS VINICOLOR Peck, Ann. Rep. N. Y. State Mus. **51**: 291. 1898

Pileus thick, fleshy, convex or nearly plane, 2.5–6 cm. broad; surface viscid, dark-red, becoming blackish on drying; lamellae distant, decurrent, olive-brown or blackish when mature; spores oblong-fusiform, smooth, smoky-brown to black, 12–14 x 3.5–4 μ; stipe subequal, glabrous, solid, vinous-red, paler within, 3–6 cm. long, 4–8 mm. thick.

TYPE LOCALITY: Lake Mohonk, New York.

HABITAT: On the ground in coniferous or mixed woods.

DISTRIBUTION: Eastern United States, New York to Alabama; also in California.

Good type specimens are to be seen on a sheet at Albany. The California plants are larger and have spores measuring about 17.5 x 5 μ. Kauffman refers a small Michigan plant to this species as a variety and says that it may be necessary to separate it specifically because of its smaller size and smaller spores.

5. GOMPHIDIUS MACULATUS (Scop.) Fries, Epicr. Myc. 319. 1838

Agaricus maculatus Scop. Fl. Carn. ed. 2, 2: 448. 1772.

Pileus solitary to subcespitose, fleshy, convex, 4–8 cm. broad; surface viscid, dull-brownish-pink, becoming black-spotted; context thick, white; lamellae short-decurrent, thick, branched, of medium width, distant, at first whitish, then blackening; spores narrowly ellipsoid, smooth, pale-brown under the microscope, 18–23 x 8 μ; stipe short, firm, equal, pale-brown, often blackening above, covered with a yellowish-brown tomentum, especially toward the base, yellowish-red within, 4–5 cm. long, 6–8 mm. thick; veil not evident.

TYPE LOCALITY: Carniola.

HABITAT: Among moss or debris in moist woods, especially under larch trees.

DISTRIBUTION: New York and Michigan; also in Europe.

ILLUSTRATION: Kauffm. Agar. Mich. *pl. 23*.

Specimens collected by Bresadola and myself in the Tyrol were described by me while fresh as follows: "Pileus viscid, smooth, glabrous, rosy-isabelline, spotted with black and becoming darker; lamellae rosy-isabelline when fresh, becoming smoky, distant, venose-connected, adnate or slightly decurrent; stipe lemon-yellow at the apex and pale-lemon-yellow at the base, smooth, glabrous, equal, concolorous, blackening like the pileus. A totally different plant from *G. viscidus*."

G. stillatus Strass., mentioned by Peck in Report 27 as occurring in the Adirondacks, should probably be referred to this species. According to Kauffman, *G. gracilis* Berk. & Br. is also probably not distinct.

6. GOMPHIDIUS FLAVIPES Peck, Ann. Rep. N. Y. State Mus. 54: 153. 1901

Pileus convex or nearly plane, 2–2.5 cm. broad; surface viscid, minutely tomentose in the center, slightly fibrillose on the margin, dingy-pink; context white; lamellae arcuate-decurrent, distant, whitish; spores oblong-fusiform, 22–30 x 6–8 μ; stipe equal or somewhat narrowed below and pointed at the base, solid, slightly fibrillose, whitish at the apex, elsewhere pale-yellow both externally and internally, 4–6 cm. long, 6–8 mm. thick.

TYPE LOCALITY: Westport, New York.

HABITAT: In mixed woods.

DISTRIBUTION: Known only from the type locality.

ILLUSTRATION: Peck, Ann. Rep. N. Y. State Mus. 54: *pl. 1, f. 1–4.*

Specimens at Albany are small, black, and very unsatisfactory for comparison. According to Kauffman, this species may be a form of *G. maculatus.*

7. GOMPHIDIUS FURCATUS Peck, Bull. N. Y. State Mus. 5: 649. 1899

Pileus fleshy, convex or nearly plane, rarely somewhat umbonate, 2.5–5 cm. broad; surface glabrous, viscid, whitish, sometimes tinged with red, occasionally with blackish stains when old or becoming blackish when bruised; context white; lamellae thick, distant, decurrent, many of them forked, whitish, becoming sooty-brown; spores oblong or subfusiform, 15–20 x 6–8 μ; stipe longer than the diameter of the pileus, rather slender, curved or flexuous, firm, solid, whitish, 3.5–7.5 cm. long, 3–6 mm. thick.

TYPE LOCALITY: Kasoag, New York.

HABITAT: Under or near tamarack trees in swamps.

DISTRIBUTION: New York.

Well represented at Albany by several good typical specimens on a sheet.

STROPHARIA (Fries) Quél., Champ. Jura Vosg. 110. 1872

Agaricus § *Stropharia* Fries, Monog. Hymen. Suec. 1: 409. 1857.
Geophila Quél. Ench. Fung. 111. 1886.

This rather large genus is distinguished by a fleshy stipe, adnate or adnexed lamellae, and the presence of an annulus, which last is somewhat uncertain at times because of its evanescent character. Several of the species grow on manure or manured ground and are widely distributed. The tropical species of this genus were treated in MYCOLOGIA for March, 1918, and the western species in MYCOLOGIA for November, 1912.

Pileus viscid or subviscid, glabrous, or slightly squamulose in two species.
  Pileus ornamented with scattered, floccose scales.
    Surface of pileus yellowish. 1. *S. distans*
    Surface of pileus greenish. 2. *S. acuminata*

Pileus glabrous, usually some shade of yellow.
- Pileus 1–5 cm. broad.
  - Pileus decidedly umbonate. — 3. *S. umbonatescens*
  - Pileus pallid, pale-tan on the disk. — 4. *S. anellariformis*
  - Pileus not as above.
    - Stipe rather short and thick.
      - Stipe 6–7 mm. thick. — 5. *S. melanosperma*
      - Stipe 3–5 mm. thick. — 6. *S. coronilla*
    - Stipe rather long and slender.
      - Stipe dry. — 7. *S. siccipes*
      - Stipe viscid.
        - Pileus remaining hemispheric. — 8. *S. semiglobata*
        - Pileus more or less expanding. — 9. *S. adnata*
- Pileus 4–15 cm. broad.
  - Stipe nearly glabrous. — 10. *S. caesiospora*
  - Stipe conspicuously revolute-scaly. — 11. *S. depilata*

Pileus not viscid, glabrous, never squamulose.
- Surface of pileus whitish or yellowish.
  - Parasitic on *Coprinus*. — 12. *S. epimyces*
  - Not parasitic in habit.
    - Pileus 5–8 cm. broad. — 13. *S. campestris*
    - Pileus 2–5 cm. broad.
      - Lamellae bluish-brown. — 14. *S. caesifolia*
      - Lamellae purplish-brown. — 15. *S. bilamellata*
- Surface of pileus some shade of brown.
  - Pileus 1–4 cm. broad.
    - Pileus brown, very thin. — 16. *S. tenuis*
    - Pileus subcinnamon-colored, fading to ochraceous. — 17. *S. merdaria*
    - Pileus rich-reddish-brown. — 18. *S. subbadia*
  - Pileus 5–15 cm. broad.
    - Lamellae whitish when young. — 19. *S. rugoso-annulata*
    - Lamellae violet when young. — 20. *S. elegans*

1. STROPHARIA DISTANS (Pers.) Morgan, Jour. Myc. **14**: 75. 1908

Agaricus distans Pers. Neues Mag. Bot. **1**: 103. 1794.
Agaricus squamosus Pers. Syn. Fung. 409. 1801; not *A. squamosus* Schaeff. 1774.
Agaricus subcernuus Schum. Enum. Pl. Saell. **2**: 255. 1803.
Stropharia squamosa Quél. Champ. Jura Vosg. 337. 1872.

Pileus fleshy, thin, convex to plane, 3–7 cm. broad; surface subviscid to dry, with concentric, superficial, floccose scales, avella-

neous-isabelline, ochraceous on the umbo; lamellae adnate or sinuate, crowded, fuliginous at maturity, white on the edges; spores oblong-ellipsoid, pale-umbrinous under the microscope, opaque, 10–14 x 6–7 μ; stipe slender, tough, stuffed or hollow, yellowish or ferruginous, squamose-villose below the annulus, 6–12 cm. long, 4–6 mm. thick; annulus ample, persistent, distant.

TYPE LOCALITY: Europe.

HABITAT: On the ground or humus in woods, fields, and gardens.

DISTRIBUTION: Northeastern United States, south to North Carolina, and west to Minnesota; also in Europe.

ILLUSTRATIONS: Berk. Outl. Brit. Fungol. *pl. 10, f. 6;* Cooke, Brit. Fungi *pl. 553* (*560*); Lucand, Champ. Fr. *pl. 190;* Ricken, Blätterp. Deutschl. *pl. 63, f. 1.*

I have specimens from Romell and Bresadola and made a collection in Kew Gardens of a number of plants growing on a mixture of humus and manure. Peck's specimens at Albany collected by him in the Catskills agree with mine from Europe.

In his 44th Report, Peck mentioned specimens collected near Salamanca that were colored a beautiful orange-red, which he considered a variety of *Stropharia squamosa* and "apparently equivalent to *Agaricus thraustus* var. *aurantiacus* of Cook's Illustrations." There are also at Albany specimens collected in Indiana by J. M. Van Hook (*No. 2558*) with the following notes:

"Pileus 6 cm. broad, orange-rufous (Ridgway), dotted with few scattered, light-yellow scales, flesh white, slightly reddish immediately beneath cuticle, not viscid (at least when dry), fleshy, flesh thin near margin, thick at center, slightly umbonate. Gills becoming dark-seal-brown. Spores purple-brown, 5–7 x 12–14 μ. Stipe equal, reaching 11 cm. long, somewhat tapering at base, above ring white and finely scaly upward, below ring darker colored with scales color of pileus. Ring complete. Stipe stuffed."

I have good specimens of the same variety collected at Kittanning, Pennsylvania, by Mr. Sumstine, and at Shingletown Gap, Pennsylvania, by Dr. Overholts (*No. 3446*). Accompanying the latter are the following notes:

"Pileus 4–8 cm. broad, convex then plane, 'zinc-orange' or 'orange-cinnamon' (Ridgway), sometimes radiate-rugose at the center and slightly umbonate, with 2 or 3 concentric rows of white appressed separable scales near the margin, these later disappearing, dry; margin at first appendiculate with

veil fragments; flesh whitish or somewhat concolorous, taste mild; gills medium-close or slightly distant, spotted, at first gray-slate color, later gray-black, squarely adnate or with a slight decurrent tooth, 4–8 mm. broad; stem long and slender, light-brown, pruinose above the annulus, with conspicuous white scales below, equal or slightly enlarged below, hollow, 8–15 cm. long, 3–6 mm. thick; annulus well developed, superior, becoming black above from the spores."

2. **Stropharia acuminata** (Scop.) comb. nov.

Agaricus acuminatus Scop. Fl. Carn. ed. 2, **2**: 447. 1772.
Agaricus viridulus Schaeff. Fung. Bavar. Ind. 1. 1774.
Agaricus aeruginosus Curt. Fl. Lond. 70. 1788.
Stropharia aeruginosa Quél. Champ. Jura Vosg. 110. 1872.

Pileus gregarious or subcespitose, fleshy, convex to plane, subumbonate, 5–10 cm. broad; surface verdigris-green, then yellowish, covered with mucus, with separable viscid pellicle, sometimes dotted with scattered white scales, especially on the margin; context soft, whitish or tinged with blue; lamellae adnate or sinuate, rather broad, crowded, pallid to grayish, at length purplish-brown, whitish-flocculose on the edges; spores ovoid or ellipsoid, smooth, subhyaline with a faint yellowish-brown tint under the microscope, 7–10 x 4–5 μ; stipe equal, hollow, viscid, scaly below the annulus, bluish, 5–8 cm. long, 5–12 mm. thick; annulus distant, rather evanescent.

TYPE LOCALITY: Carniola.

HABITAT: On the ground among leaves or in woods; also in fields in moist regions of Europe.

DISTRIBUTION: Rare from New England to South Carolina and west to California; abundant in Europe.

ILLUSTRATIONS: Bull. Herb. Fr. *pl. 530, f. 1;* Cooke, Brit. Fungi *pl. 551* (*555*); Curt. Fl. Lond. *pl. 309;* Gill. Champ. Fr. *pl. 132* (*650*); Hussey, Ill. Brit. Myc. **1**: *pl. 35;* Pat. Tab. Fung. *f. 231;* Schaeff. Fung. Bavar. *pl. 1;* Sow. Engl. Fungi *pl. 264;* Trans. Wisc. Acad. Sci. **17**: *pl. 64.*

This very attractive species is rare in the United States, but I have found it abundant in Sweden, England, and other parts of Europe.

3. STROPHARIA UMBONATESCENS (Peck) Sacc. Syll. Fung. **5**: 1021. 1887

Agaricus umbonatescens Peck, Ann. Rep. N. Y. State Mus. **30**: 41. 1878.

Pileus at first conic, subacute, then expanded and umbonate, gregarious, 1–2.5 cm. broad; surface smooth, glabrous, viscid, yellow, the umbo inclining to reddish; context thin, pallid, with a fetid odor; lamellae adnate to slightly decurrent, crowded, plane, broad, at length ventricose, whitish or gray to blackish-brown, with a slight olivaceous tint; spores ellipsoid, smooth, purplish-brown under the microscope, 15–19 x 10 μ; stipe equal, slender, stuffed to hollow, pallid with a yellowish tint, 5–10 cm. long; annulus scanty, fugacious.

TYPE LOCALITY: Schenevus, New York.

HABITAT: On manure in pastures.

DISTRIBUTION: Massachusetts, New York, and Michigan; probably also in Europe.

ILLUSTRATIONS: Kauffm. Agar. Mich. *pl. 51, f. 1;* Trans. Wisc. Acad. Sci. 17: *pl. 65, f. B.* Compare Kalchb. Ic. Hymen. Hung. *pl. 16, f. 2.*

The real type of this species was collected at Schenevus. Certain other specimens so named at Albany are distinct. Sterling's specimens are wrongly named; Morris's, from Massachusetts, are correct. Kauffman says it is not infrequent in Michigan, having large spores and a rather fetid odor, and being near to *S. paradoxa* P. Henn. in shape. Harper suggests that it may be *Stropharia mammillata* Kalchb., a species published in 1874. I have specimens of this from Bresadola and they certainly look like our plant. Manure-inhabiting fungi have a way of getting about and turning up almost anywhere.

4. **Stropharia anellariformis** sp. nov.

Pileus thick, convex, obtuse, 2 cm. broad; surface viscid, smooth, not striate, pallid, pale-tan on the disk; lamellae decurrent, subdistant, broad, pale-tan to fuscous, with a purplish tint; spores broadly ellipsoid or ovoid, slightly apiculate, dark-purplish-brown under the microscope, 9–10 x 7–8 μ; stipe subcylindric, larger toward the apex, atomaceous above, fibrillose below, dry, solid, concolorous, 4–5 cm. long, 2–3 mm. thick; annulus persistent, distant 1 cm. from the pileus.

TYPE LOCALITY: New Orleans, Louisiana.

HABITAT: On manure.

DISTRIBUTION: Known only from the type locality.

Type collected by F. S. Earle (*43*) on September 4, 1908. The species suggests *Anellaria fimiputris* and the spores resemble those of *Anellaria* and *Campanularius* in form but are lighter in color, staining the lamellae purplish-brown rather than black.

5. STROPHARIA MELANOSPERMA (Bull.) P. Karst. Bidr. Finl. Nat. Folk 32: 489. 1879

Agaricus melaspermus Fries, Epicr. Myc. 219. 1838.

Pileus fleshy, soft, convex to plane, obtuse, 3.5–4.5 cm. broad; surface smooth, glabrous, slightly viscid, often areolate, white, straw-colored on the disk; lamellae slightly adnexed, crowded, ventricose, pallid to cinereous, then violet-black; spores ovoid, fuscous, 10 x 6 μ; stipe equal, glabrous, hollow, white, 4–6 cm. long, 6–7 mm. thick; annulus membranous, white.

TYPE LOCALITY: Europe.

HABITAT: On manure or manured ground in the open or partially shaded.

DISTRIBUTION: New England, New York, Texas, Costa Rica, etc.; also in Europe.

ILLUSTRATIONS: Bres. Fungi Trid. *pl. 61;* Cooke, Brit. Fungi *pl. 536 (559)*; Pat. Tab. Fung. *f. 555;* Schaeff. Fung. Bavar. *pl. 51;* Quél. Champ. Jura Vosg. *pl. 24, f. 3;* Bull. Champ. Fr. *pl. 540, f. 1.*

Specimens so named are at Albany, collected by Burnham on lawns in Albany in August, 1905. Similar plants were found by me at Lake Placid, growing scattered under a white pine tree in the open, and I described them as follows: "Pileus semiglobose, 5 cm. broad; surface smooth, glabrous, dry when found, pure-white, becoming slightly yellow in spots on drying; context white, firm, eaten by snails; lamellae sinuate-adnate, crowded, plane, 3–4 times inserted, pure-white at first, notched on the edges; stipe equal, dry, apparently solid, fibrillose-scaly, finely frosted above the tiny, apical ring-trace, 7 cm. long, 7 mm. thick; veil slight, white, evanescent."

Specimens from Bresadola resemble *S. bilamellata* in general shape and have dark-colored lamellae with spores that are broadly ellipsoid, smooth, umbrinous under the microscope, reminding one of *Panaeolus* in shape, slightly apiculate, about 10–12 x 7–8 μ.

Bulliard's figures show the gills of young plants to be nearly white, becoming practically black when colored by the matured spores. He did not describe the species and I do not find it in DeCandolle's treatment of Bulliard's plants. Fries, according to Bresadola, confused it with Bulliard's *A. coronilla.* The original spelling was *A. melanospermus,* although practically every author using the name since Bulliard's time has abbreviated it to *A. melaspermus. A. bulbularis* Batsch has been called a synonym, but his figure is quite different from Bulliard's and shows no annulus at all.

6. STROPHARIA CORONILLA (DC.) Quél. Champ. Jura Vosg. 237. 1872

Agaricus coronilla DC. Fl. Fr. **2**: 202. 1805.

Pileus hemispheric to convex, at length expanded, 2–4 cm. broad; surface glabrous, slightly viscid, smooth, whitish or ochraceous, even and whitish-floccose or appendiculate on the margin; context white, firm, with a slight, unpleasant odor; lamellae adnate or sinuate, rather broad, crowded, pallid to dark-violet and at length purplish-black, the edges whitish-fimbriate; spores ellipsoid or ovoid, smooth, violet-purple under the microscope, 8–12 x 4–6 μ; stipe equal or slightly tapering upward, dry, smooth, white or slightly yellowish, solid to hollow, flocculose above the annulus, fibrillose below, becoming shining, 3–4 cm. long, 3–5 mm. thick; annulus distant, striate above, white, persistent.

TYPE LOCALITY: France.

HABITAT: On the ground in pastures, gardens, or woods.

DISTRIBUTION: Infrequent in the northeastern United States westward to Wisconsin and Kansas; also in Europe.

ILLUSTRATIONS: Bull. Herb. Fr. *pl. 597, f. 1;* Cooke, Brit. Fungi *pl. 535* (*558*); Pat. Tab. Fung. *f. 232;* Ricken, Blätterp. Deutschl. *pl. 63, f. 5;* Trans. Wisc. Acad. Sci. **17**: *pl. 65, f. A.*

EXSICCATI: Ellis & Ev. N. Am. Fungi *3511.*

Peck thought his *S. bilamellata* might be this species. According to Kauffman, *S. melanosperma* is not very different; and Saccardo and Ricken say that *S. obdurata* is the same. Specimens collected by Bartholomew in Kansas appear to agree with authentic material from Bresadola and with specimens collected by me in Europe.

7. STROPHARIA SICCIPES P. Karst. Medd. Soc. Faun. Fl. Fenn. 9: 46. 1882

Pileus subfleshy, hemispheric to expanded, obtuse, orbicular, 2–3 cm. broad; surface glabrous, viscid, clay-white, yellowish on drying, even or pellucid-striate on the margin; lamellae adnate-subdecurrent, clay-colored to fuscous; spores ellipsoid, pellucid-brown, 12–15 x 7–9 μ; stipe flexuous or strict, subfibrillose, flocculose above the annulus, dry, stuffed or hollow, pallid, 4–7 cm. long, 2 mm. thick; annulus incomplete, dry, distant, subfloccose or pruinose.

TYPE LOCALITY: Finland.

HABITAT: On manure or manured ground.

DISTRIBUTION: Northeastern United States westward to Minnesota; also in Europe.

ILLUSTRATIONS: Trans. Wisc. Acad. Sci. 17: *pl. 66, f. D, E, & F*; 18: *pl. 18, f. I.*

Peck described a variety of this species as *S. siccipes radicata* in Mus. Bull. 67: 37. 1903, based on long-radicate specimens collected by Earle in June in the New York Botanical Garden. Harper described and figured both the species and the radicate variety. Karsten considered it a form of *Stropharia semiglobata.*

8. STROPHARIA SEMIGLOBATA (Batsch.) Quél. Champ. Jura Vosg. 112. 1872

Agaricus semiglobatus Batsch, Elench. Fung. Contin. 1: 141. 1786.

Pileus fleshy, subglobose to hemispheric, not expanding, gregarious to subcespitose, 1–4 cm. broad; surface light-yellow, smooth, glabrous, very viscid when moist; context pallid, soft; lamellae adnate, very broad, white or olive-gray, soon clouded with the ripening spores; spores ellipsoid, smooth, purplish-brown, 12–18 x 7–10 μ; cystidia on edges of lamellae 30–45 x 3–4 μ; stipe slender, cylindric, light-yellow, smooth, viscid, 6–9 cm. long, 2–4 mm. thick; veil glutinous when moist, leaving an incomplete, superior ring.

TYPE LOCALITY: Germany.

HABITAT: On manure or manured ground in fields or open woods.

DISTRIBUTION: Throughout temperate North America and Europe, and at high elevations in the tropics.

ILLUSTRATIONS: Atk. Stud. Am. Fungi *f. 30;* Batsch, Elench. Fung. *f. 110;* Bull. U. S. Dept. Agr. 175: *pl. 25, f. 2;* Cooke, Brit. Fungi *pl. 539* (*567*); Curt. Fl. Lond. *pl. 194* (as *A. glutinosus*); Hard, Mushr. *f. 260;* Hussey, Ill. Brit. Myc. **1**: *pl. 39, f. 2;* Mycologia **4**: *pl. 56, f. 3;* Palmer, Mushr. Am. *pl. 12, f. 3, 4;* Pat. Tab. Fung. *f. 234;* Ricken, Blätterp. Deutschl. *pl. 63, f. 2;* Sow. Engl. Fungi *pl. 248;* Trans. Wisc. Acad. Sci. **18**: *pl. 18, f. A–H.*

A very common and easily recognized species. The spores vary considerably in size. Harper says there is a sterile form which differs only in having the gills white, unchanging, because there are no spores to blacken them. He gives an illustration of it.

9. **Stropharia adnata** (Huds.) comb. nov.

Agaricus adnatus Huds. Fl. Angl. ed. 2, 619. 1778.
Agaricus stercorarius Schum. Enum. Pl. Saell. **2**: 286. 1803; not *A. stercorarius* Bull. 1781.
Stropharia stercoraria Quél. Champ. Jura Vosg. 112. 1872.
Hypholoma pecosense Cockerell, Jour. Myc. **10**: 108. 1904.

Pileus solitary or gregarious, hemispheric to expanded, 2–5 cm. broad; surface smooth, glabrous, viscid, often cracking on drying, whitish or some shade of light-yellow, margin even; context soft, white or yellowish, slightly bitter; lamellae adnate with decurrent tooth, very broad, crowded, white to brownish or greenish-black, whitish-flocculose on the edges; spores smooth, elongate-ellipsoid, violet-purple under the microscope, blackish-brown in mass, 16–20 x 10–12 μ; stipe elongate, equal or enlarged at the base, stuffed to hollow, subviscid, flocculose-scaly below the annulus, pruinose above, 8 cm. or more long; annulus distant, slight, evanescent.

TYPE LOCALITY: England.

HABITAT: On manure.

DISTRIBUTION: Temperate regions of North America; also in Europe.

ILLUSTRATIONS: Cooke, Brit. Fungi *pl. 538* (*566*); Trans. Wisc. Acad. Sci. **17**: *pl. 67.*

Similar to *S. semiglobata* in habit and appearance, but gills becoming brownish-black or greenish-black instead of cloudy-black, and spores usually lighter in color, appearing olivaceous under a microscope. The cap is also not so persistently hemispheric as in

S. semiglobata. The two species approach each other very closely at times.

10. STROPHARIA CAESIOSPORA Kauffm. Mycologia 9: 166. 1917

Pileus convex, obtuse, firm or slightly elastic, gregarious, 4–9 cm. broad; surface chamois to honey-yellow (Ridg.), subviscid, even; margin somewhat crenate-lobed; context white, rather thick and compact, thin on the margin; lamellae crowded, narrow, adnexed-emarginate, at length rounded behind, heterophyllous, drab to hair-brown or ashy-gray; spores minute, ovoid, smooth, with a purplish-cinereous tint under the microscope, ashy in mass with a tint of purple, 5–6 x 3–4 μ; stipe equal or slightly bulbous at the base, whitish, slightly lacerate above the annulus, stuffed to solid, fibrillose-glabrescent, 4–9 cm. long, 6–12 mm. thick; annulus persistent, membranous, flocculose below, striate-ridged above, becoming gray from the spores.

TYPE LOCALITY: Elkmont, Tennessee.

HABITAT: On the ground among debris in chestnut and conifer mixed woods.

DISTRIBUTION: Found several times in the vicinity of Elkmont.

11. STROPHARIA DEPILATA (Pers.) Sacc. Syll. Fung. 5: 1012. 1887

Agaricus depilatus Pers. Syn. Fung. 408. 1801.
? *Stropharia Hardii* Atk. Jour. Myc. 12: 194. 1906.

Pileus solitary or gregarious, convex to plane, obtuse, 4–15 cm. broad; surface glabrous, viscid, livid-yellow to cinnamon; margin even, often appendiculate; context firm, whitish, with somewhat disagreeable taste and no odor; lamellae rather crowded, adnate-decurrent, broad, white to purplish-black; spores ellipsoid, smooth, dark-gray with a purplish tint under the microscope, 9–14 x 5–8 μ; stipe equal, solid to hollow, revolute-scaly below the annulus, floccose-scaly above, white to pale-yellow, 6–20 cm. long, 1–1.5 cm. thick; annulus distant, ample, scaly, white, persistent.

TYPE LOCALITY: Europe.

HABITAT: On much-decayed wood or humus in woods.

DISTRIBUTION: Northeastern United States westward to Michigan; also in Europe.

ILLUSTRATION: Trans. Wisc. Acad. Sci. 17: *pl. 62, 63.*

Specimens from Bresadola and Romell are in the Garden herbarium. Plants collected by me late in August on humus under a pine log in Maine, where I obtained several collections, had a "pale, dull-yellow cap, which was viscid when fresh; white, appendiculate margin; stipe and edges of gills pure-white." I also found it twice in deep, rich woods in the Adirondacks. Peck's specimens were at first referred to *Agaricus Hornemanni,* which was Fries's name for this species before he adopted that of Persoon. *Stropharia Hardii,* according to Harper, is probably this species, although the spores are described as smaller. I have not seen the types.

12. STROPHARIA EPIMYCES (Peck) Atk. Plant World **10**: 128. 1907

Panaeolus epimyces Peck, Ann. Rep. N. Y. State Mus. **35**: 133. 1884.

Stropharia coprinophila Atk. Jour. Myc. **8**: 118. 1902.

Pileus fleshy, at first subglobose, then convex to expanded, 2–6 cm. broad; surface white, then dingy, silky-fibrillose; context soft, white or whitish, with mild odor and taste; lamellae adnexed, rounded behind, somewhat crowded, dingy-white, becoming brown or blackish, with white edges; spores ellipsoid, smooth, dark-purplish-brown under the microscope, almost black in mass, 7–8.5 x 4–6 μ; cystidia clavate or subventricose, on a slender stalk, 40–60 x 10–14 μ; stipe short, stout, tapering upward, strongly striatulate and minutely mealy or pruinose, solid in the young plant, hollow in the mature plant, but with the cavity small, white-annulate near the base from the white, floccose veil, 2.5–7 cm. long, 5–15 mm. thick.

TYPE LOCALITY: North Greenbush, New York.

HABITAT: Parasitic in groups on *Coprinus comatus, C. atramentarius,* and perhaps other species of the genus.

DISTRIBUTION: Northeastern North America, Canada to New York and west to Minnesota; perhaps also in Europe.

ILLUSTRATIONS: Plant World **10**: *f. 22–24;* Hard, Mushr. *f. 227;* Jour. Myc. **2**: *pl. 80;* Mycologia **8**: *pl. 178, f. C, D; pl. 179, f. A, B.*

Interesting studies have recently been made of this rather queer species by Harper, Atkinson, Kauffman, and McDougall. Harper

calls attention to Lanzi's figures of *Pilosace algeriensis* as closely resembling our plant. Kauffman, as well as McDougall, says our plant is not a *Pilosace,* and he keeps it in *Stropharia* where Atkinson placed it. Specimens growing on *Coprinus comatus* were sent me in 1915 by Mr. Boughton, of Pittsford, New York, but they were not in good shape for study. My notes on them read: "Pileus cream-colored, 6 cm. broad; context white, taste mild; lamellae like those of *Agaricus campestris* in appearance; stipe white, 5 cm. long, 1.4 cm. thick. Not a *Panaeolus*, but like *Agaricus* without a ring." These would seem to agree with Harper's latest conclusions, but not with McDougall's.

13. **Stropharia campestris** Peck ms.

Pileus convex to plane or nearly so, gregarious, 5–8 cm. broad; surface smooth, moist when fresh, yellowish-white or cream-colored, becoming darker on drying; context compact, yellowish-white, with farinaceous or slightly bitter taste; lamellae thin, adnate, slate-colored tinged with violaceous, becoming blackish-brown tinged with purple; spores ellipsoid, purplish-brown, 10–12 x 6–8 μ; stipe equal or slightly bulbous at the base, solid, annulate, white, 2.5–5 cm. long, 4–10 mm. thick.

TYPE LOCALITY: Morrisville Island, Pennsylvania.

HABITAT: On grassy ground.

DISTRIBUTION: New York and Pennsylvania.

According to Mr. Sterling, the bitter taste is destroyed by cooking and the mushroom is edible and better in flavor than *Agaricus campester,* for which it is sometimes mistaken and from which it may be separated by its adnate, not free, gills. The gills are at first concealed by the white veil, which finally ruptures and adheres partly to the margin of the pileus and partly to the stem. It is closely related to *Stropharia caesifolia,* from which it differs in the color of the gills and possibly in flavor.

The above description and notes made by Dr. Peck were kindly furnished me by Dr. House. The type of this species was collected in August, 1905, by E. B. Sterling. I also have plants collected by L. M. Underwood on the Columbia Campus in October, 1899.

14. STROPHARIA CAESIFOLIA Peck, Bull. Torrey Club **22**: 489. 1895

Pileus convex, 2.5–5 cm. broad; surface glabrous, white or whitish, sometimes brownish on the disk; lamellae close, rounded or emarginate behind, light-blue becoming dingy-bluish-brown; spores subellipsoid, 10–12.5 x 6–7.5 μ; stipe equal or slightly thickened at the base, solid, glabrous, white or whitish, 2.5–4 cm. long, 4–6 mm. thick; annulus white.

TYPE LOCALITY: Rockport, Kansas.

HABITAT: In low sandy pastures.

DISTRIBUTION: Known only from the type locality.

A portion of the type is in the Garden herbarium. Bartholomew remarks that this species is much like the common mushroom, except that its gills have a fine light-blue color instead of pink. In the dried specimens they are dingy-grayish-blue, inclining to brown.

15. STROPHARIA BILAMELLATA Peck, Bull. Torrey Club **22**: 204. 1895

Pileus fleshy, convex, becoming nearly plane in large plants, obtuse, 2.5–5 cm. broad; surface even, whitish or yellowish, glabrous; context pure-white; lamellae thin, close, adnate, purplish-brown in mature plants; spores ellipsoid, purplish-brown, 10 x 5–6 μ; stipe commonly short, solid, sometimes hollow in large plants, white, annulate, 2.5 cm. long, 6–8 mm. thick; annulus well-developed, pure-white, striately lamellate on the upper edge.

TYPE LOCALITY: Pasadena, California.

HABITAT: In grass in streets or in cultivated fields.

DISTRIBUTION: New York to Alabama; also in California.

ILLUSTRATION: Bull. N. Y. State Mus. 122: *pl. 112, f. 5–10.*

Described from California, but found also at a few places in the eastern United States. Mr. B. C. Williams collected it at Newark, New York; Braendle at Washington, D. C.; Coker at Chapel Hill, North Carolina; and Earle at Auburn, Alabama. When Peck received Braendle's specimens, he revised his description. The species resembles *S. coronilla.*

16. **Stropharia tenuis** sp. nov.

Pileus convex, subumbonate, thin, 2.5 cm. broad; surface dry, with delicate, floccose patches, faintly striate, brown; lamellae ad-

nexed, crowded, of medium width, subconcolorous; spores broadly ellipsoid, obtuse at both ends, smooth, dark-purplish-brown under the microscope, 7 x 5 μ; stipe slender, fragile, tapering upward, enlarged at the base, glabrous, silky, hollow, concolorous but slightly paler, 7 cm. long, 2–3 mm. thick; annulus distant 2.5 cm. from the pileus, ample, persistent.

TYPE LOCALITY: Chalmitte, New Orleans, Louisiana.

HABITAT: On the ground in wet woods.

DISTRIBUTION: Vicinity of New Orleans, Louisiana.

Collected by F. S. Earle, *No. 116* (type), September 8, 1908; also on September 7, 1908, *No. 101*. A thin, fragile plant resembling certain species of *Drosophila,* but having an ample, persistent annulus. The color of the pileus in dried specimens varies from avellaneous to umbrinous or fuliginous; the stipe and annulus being nearly white.

17. STROPHARIA MERDARIA (Fries) Quél. Champ. Jura Vosg. III. 1872

Agaricus merdarius Fries, Syst. Myc. 1: 291. 1821.

Pileus gregarious, convex to plane, obtuse, 3–4 cm. broad; surface glabrous, moist, hygrophanous, becoming striatulate, subcinnamon-colored when moist, ochraceous when dry; lamellae adnate, broad, yellowish to umbrinous; spores globose to ellipsoid, brownish-black, 12–17 x 6–9 μ; stipe tough, short, stuffed or hollow, dry, flocculose, pallid, 2.5 cm. or more long; annulus lacerate, fugacious; veil often appendiculate.

TYPE LOCALITY: Sweden.

HABITAT: On manure.

DISTRIBUTION: North central United States; also in Europe.

ILLUSTRATIONS: Cooke, Brit. Fungi *pl. 537 (565)*; Fries, Ic. Hymen. *pl. 130, f. 3;* Lucand, Champ. Fr. *pl. 139;* Ricken, Blätterp. Deutschl. *pl. 66, f. 1.*

I have excellent material collected by Romell and myself in Sweden, in which the spores are elongate-ellipsoid, smooth, opaque, yellowish under the microscope, reaching 17 x 9 μ. Harper describes and figures what he considers *S. submerdaria* Britz., and says that Morgan refers it to *S. merdaria* as a variety. Kauffman finds this species in Michigan and follows Karsten in placing it in *Psilocybe,* since the stipe is described as tough.

18. **Stropharia subbadia** sp. nov.

Pileus rather fleshy, convex to nearly plane, solitary or gregarious, 1–2 cm. broad; surface smooth, dry, rich-reddish-brown, lighter on the margin, which is not striate, covered with an evanescent yellowish tomentum when young; lamellae sinuate, subventricose, not crowded, rather broad for the size of the plant, whitish to dark-cinereous, at length purplish-brown, entire and whitish on the edges; spores ellipsoid, smooth, pale-purplish-brown under the microscope, about 7.5–8.5 x 5.5 μ; stipe short, of medium thickness, equal, fibrillose-scaly, especially below, tawny-white, 2–3 cm. long, 2–3 mm. thick; veil slight, white, mostly becoming distributed along the stipe instead of forming a definite annulus.

TYPE LOCALITY: Auburn, Alabama.

HABITAT: On the ground in dry pastures.

DISTRIBUTION: Vicinity of Auburn, Alabama.

This may belong to *Drosophila;* a study of fresh plants is needed. Dried specimens suggest dried specimens of *S. coronilla,* but are differently colored and lack the ample, persistent annulus. The types were collected by F. S. Earle on October 16, 1900. Also collected by him on October 14, 1900, near the type locality in a close-cropped pasture of Bermuda grass.

19. **Stropharia rugoso-annulata** Farlow ms.

Pileus fleshy, hemispheric to convex, 5–15 cm. broad; surface glabrous or at times slightly and innately fibrillose on the margin, chestnut-colored, becoming paler on drying; context firm, thin, whitish, with mild taste; lamellae thin, crowded, wider than the thickness of the pileus, adnate, whitish when young, becoming dark-brown or almost black with age; spores ellipsoid, dark-brown, 10–12 x 6–8 μ; stipe equal or slightly tapering upward, spongy within, sometimes becoming hollow with age, whitish, silky-fibrillose, with mycelium at the base at times, 5–8 cm. long, 10–12 mm. thick; annulus whitish, appearing double, the lower membrane radiately splitting on the margin.

TYPE LOCALITY: Newton, Massachusetts.

HABITAT: Rich, cultivated grounds.

DISTRIBUTION: Massachusetts.

Two collections are at Albany, one from George E. Morris and the other from G. B. Fessenden. I have specimens collected by Morris in a corn field at Waban, Massachusetts, September 13,

1905. The descriptive notes were kindly supplied in manuscript by Dr. House.

20. **Stropharia elegans** sp. nov.

Pileus fleshy, convex to plane, upturned at the margin in dried specimens, solitary, 5–10 cm. broad; surface dry or slightly moist, nearly smooth, glabrous, subshining, umbrinous, tinged with light-brown in younger stages, becoming isabelline-ochraceous-melleous at maturity; context white, very thin, except at the center, without characteristic odor, taste mild and peculiar, like some bulbs; lamellae adnexed, arcuate, crowded, rather narrow, entire and concolorous on the edges, dark-smoky to dark-violet, at length purplish-fuliginous; spores ovoid, smooth, umbrinous under the microscope, about 10–12 x 7–8 μ; stipe slender, tapering decidedly upward from a bulbous base, glabrous, solid, white, smooth, and shining above the annulus, cream-colored below and longitudinally striate just below and near the annulus, 10–12 cm. long, 2–3 cm. thick at the base, 5–10 mm. thick at the apex; annulus large, membranous, white or slightly yellowish, fixed, distant about 3 cm. from the pileus, lobed on the margin.

TYPE LOCALITY: New York Botanical Garden, New York City.

HABITAT: In rich, low, partly shaded soil.

DISTRIBUTION: Known only from the type locality.

Collected on September 12, 1912, by Miss Mary E. Eaton and drawn in color by her. She found larger specimens at the same spot on September 16, 1912. A very beautiful plant, with brownish-umber cap, dark-violet gills, and a yellow stipe which tapers upward decidedly from a bulbous base.

DOUBTFUL AND EXCLUDED SPECIES

Stropharia albocyanea (Desmaz.) Quél. Champ. Jura Vosg. 236. 1872. According to Harper, this species occurs with us, being smaller than *S. aeruginosa* and having a white, dry stipe. Morgan referred to it as *S. pseudocyanea* (Letell.). Peck's specimens so named, from North River, New York, and those collected by Simon Davis at North Bethlehem, New Hampshire, differ from each other and from Bresadola's specimens.

Stropharia albonitens (Fries) Quél. Champ. Jura Vosg. 3: 11. 1875. Reported from Michigan by Kauffman, who says that it

may be known by the gray color of the gills and the yellowish tint on the stem in age.

Agaricus (Stropharia) Feildeni Berk. Jour. Linn. Soc. **17**: 14. 1880. Collected on Bellot Island, Greenland, by Captain Feilden. The description is inadequate and I have not seen the type. Miss Wakefield, however, has kindly examined it for me and writes as follows:

"The type consists of one specimen about 6 cm. across in very bad condition. There is practically no stalk, only a mass of soil beneath. It gives one the impression of having been a dwarf, abnormal form. The upper surface of the pileus is also much covered with soil, so that one can judge little about it. The gills, as much as one can see of them, are very short. If it were ever found again the spores might serve to identify it. They are almost globose, and rather large, 7–9 x 7–8 μ."

Stropharia Howeana (Peck) Sacc. Syll. Fung. **5**: 1026. 1887. (*Agaricus Howeanus* Peck, Bull. Buffalo Soc. Nat. Sci. **1**: 53. 1873.) See *Pholiota Howeana* Peck, Bull. N. Y. State Mus. 122: 147. 1908.

Stropharia irregularis Peck, Bull. Torrey Club **27**: 16. 1900. An annulate form of *Drosophila appendiculata*.

Stropharia Johnsoniana Peck, Ann. Rep. N. Y. State Mus. **41**: 84. 1888. (*Agaricus Johnsonianus* Peck, Ann. Rep. N. Y. State Cab. **23**: 98. 1872.) See *Pholiota Johnsoniana* Peck, Bull. N. Y. State Mus. 122: 147. 1908.

Stropharia micropoda Morg. Jour. Myc. **14**: 73. 1908. Described from specimens growing on rotten wood at Preston, Ohio. Stover suggests that it may not be distinct from *Gymnopilus polychrous*.

Stropharia obturata (Fries) Quél. Champ. Jura Vosg. 110. 1872. (*Agaricus obturatus* Fries, Syst. Myc. **1**: 283. 1821.) Reported from Illinois on the basis of a photograph taken by W. S. Moffatt. According to some, the species is not distinct from *S. coronilla*. Peck's specimens so named appear to belong in *Pholiota*.

Stropharia Schraderi Peck, Bull. Torrey Club **32**: 80. 1905. Described from specimens collected by F. F. Schrader in sandy, grassy soil about stumps at Washington, D. C. The types have been examined and the species appears to me to belong in *Pholiota*.

Stropharia umbilicata Peck, Bull. N. Y. State Mus. 167: 49. 1913. Described from specimens collected among chips and sawdust in Minnesota. The types at Albany resemble *S. aeruginosa* in some ways, but are probably *Gymnopilus polychrous*, since specimens from New York called *S. umbilicata* by Peck seem identical with the Minnesota types and also with *G. polychrous*.

NEW YORK BOTANICAL GARDEN.

THE METHOD OF CLEAVAGE IN THE SPORANGIA OF CERTAIN FUNGI

Carl A. Schwarze

[With Plates 15 and 16 and Text-figures A–F]

The division of the multinucleated sporangia into spores and the delimitation of the sporangium from the sporangiophore by a dome-shaped cross partition present many features of special cytological interest. Erroneous views on both processes are still current in the literature and as to the formation of the columella certain textbooks, both old and recent, are still entirely out of harmony with the facts. The literature dealing with the common molds, *Mucor* and *Rhizopus,* constitutes some of the earliest contributions to mycological research.

Corda (11), the "father of microscopic mycology," gave us the first description and illustration of the method of the columella and spore formation in *Ascophora mucedo,* now known as *Rhizopus nigricans.* He writes: "Nun rundet sich die kolbige Verdickung allmälig, und gleichzeitig erfüllt die gelbe Masse ihren Hohlenraum vôllig . . . aus dem unteren Theile mit dem Stiele verbunden beginnt allmälig die polsterartige Erhebung der Columella, und gleichzeitig beginnt die obere Masse undeutliche und noch isolirte Zellen zu bilden welche sich vermehren und endlich in enger Verbindung die ganze Sporangie erfüllen." His figure 78 (5–9) depicts the columella as at first slightly arched and gradually pushing up into the sporangium, while the spores are represented, at their very inception, as polyhedral masses. These figures of Corda are doubtless responsible for the persistent, erroneous accounts of the columella formation still to be found in certain textbooks, though Corda's statements were soon contradicted by Fresenius.

Fresenius (20), also studying *Rhizopus nigricans,* states he was unable to observe the phenomena described and figured by Corda. He writes: "Was über Bau und Entwickelung der Sporen bei Corda gesagt und abgebildet ist scheint mir völlig aus der Luft gegriffen zu sein." Further, also as early as 1872, Brefeld (7),

studying *Mucor mucedo,* made the following statement: "Die Scheidewand ist nicht etwa ursprünglich horizontal und erhällt ihre gewölbte Form durch Dehnung unter dem einfluss des Druckes der Flüssigkeitssaüle im Fruchtträger, wie mehrfach angegeben wird, sie hat in der ersten Anlage die gewölbte Gestalt, die nachträglich nur unwesentlich modificirt wird."

Mucor mucedo and *Rhizopus* have been used as types not only in advanced and elementary textbooks of botany, but in many so-called textbooks of biology. Here especially the desire to elaborate in detail on the life processes beyond what is in the literature has led to many false statements, which should certainly be corrected in the interest of sound teaching. Illustrations of such incorrect statements are found in the following texts:

Bessey (4) figures and describes the development of the sporangium of *Mucor mucedo* as follows: ". . . the vertical hyphae which are filled with protoplasm become enlarged at the top and in each a transverse partition forms (*A, a,* fig. 159), the portion above the partition (*b,* fig. 159) becomes larger, and at the same time the transverse partition arches up (*B, a,* fig. 159), finally appearing like an extension of the hypha, and is then called the columella (*C, a,* fig. 159)." Reynolds Green (21), referring to *Mucor mucedo,* states: "A septum is formed close to the apex of the hypha, cutting off a small head, which grows and becomes globular. The lower cell grows also and projects into the swollen portion, forming a columella." Parker (40), referring to *Mucor,* states: ". . . The sporangium continues to grow, and as it does so the septum becomes more and more convex upwards, finally taking the form of a short club-shaped projection, the columella, extending into the interior of the sporangium." Atkinson (1) writes: ". . . at the same time that this end cell is enlarging the cross wall is arching up into the interior. This forms the columella." Coulter, Barnes and Cowles (13), referring to the Mucorales, write: "After the terminal sporangium cell is cut off, the separating wall bulges into the sporangium cavity, forming the so-called columella." Bigelow (5) incorporates in his text Parker's faulty figure of the method of the columella formation. Nathansohn (38) states: ". . . durch eine Querwand schnürt sich an deren Spitze eine

Zelle ab, schwillt zur Kugel an, in deren Hohlraum sich die Querwand meist mehr oder weniger einstülpt und die sog. Columella bildet." In so recent a textbook as Densmore's General Botany (17) we find: "This sporangial cell now expands with great rapidity and with its expansion the wall separating it from its hyphal stalk grows in surface area and assumes a convex form, protruding into the growing sporangium until it comes to occupy fully one half or two thirds of the sporangial cavity, when it is called the columella." Densmore also figures (fig. 141) the columella as at first a plane wall, which is later arched up into the sporangium.

The method of spore formation in sporangia was studied, with interesting results, as early as 1859, following the discovery of cell formation by division, as worked out by Von Mohl and others, and has been prosecuted up to the present day. While the pioneers were influenced and sometimes misled by theories relative to cell formation in general, the fact remains that as early as 1859 Pringsheim (44) observed and figured progressive cleavage from the surface inward, essentially as we know the process today, in the sporangia of *Lagenidium entophytum* (Pringsheim), Zopf (*Pythium entophytum* Pringsheim). He writes as follows: "Erst vor der Oeffnung des Sporangium beginnt nun in dem ausgetretenen, zur Kugel zusammen gebalten Inhalt, eine an der Peripherie beginnende und nach dem Centrum vorschreitende Sonderung durch welche die Protoplasmakugel schliesslich in eine grössere Anzahl von Schwarmsporen zerfällt [Pl. 8, fig. 1*b*]."

General conclusions relative to spore formation in sporangia found in some recent papers are quite at variance with observations which seem well established by earlier students. One must infer that some of the recent writers must have overlooked Rothert's (46) paper entitled, "Die Entwicklung der Sporangien bei den Saprolegnieen."

The general history of this literature has been treated by Swingle (50) and recently by Moreau (37) and Harper (25). I shall refer only to points bearing on matters that seem still unsettled, especially the question as to the occurrence of so-called simultaneous cell-division.

Van Tieghem (55–56–57), in a series of papers dealing practically with the entire group of Zygomycetes, undoubtedly laid the foundation for the later conception of simultaneous division. In reference to *Sporodinia,* he writes as follows: "Le protoplasma sporigene se separe d'abord en deux substances tres differente. La premiere toujours granuleuse, se condense en petites portions polyedriques qui deviendront bientot autant de spores."

Twenty years later Leger (34), in his very fully illustrated thesis, dealing with fourteen species of Zygomycetes, quotes Van Tieghem's reference to the manner of spore formation in *Sporodinia* and adds: "En somme, ce passage montre d'une facon tres exacte le developpement des spores dans ses traits principaux." The discovery of cell-plates in the division of the cells of the higher plants undoubtedly influenced the conclusions of many students of spore formation.

Strasburger (48–49) for *Saprolegnia* and *Mucor mucedo,* Büsgen (8) for the Saprolegniales, *Phytophthora, Cystopus* and *Mucor mucedo,* Ward (59) for *Phytophthora infestans,* and Maurizio for *Olpidiopsis* state that the cell-division in these forms is by cell-plates.

Fischer (19), studying spore formation in the sporangia of *Woronina,* describes the process as follows: "der Zerfall des Sporangiumplasma in eine der grosse desselben entsprechende Anzahl anfangs polyedrischen Portionen, die zukünftigen Schwärme." Van Tieghem, as noted, refers to a condensation into polyhedral portions. Fischer observes a breaking up into polyhedral masses. It is interesting to note that the same author (Fischer (19)) regarded the spore plasm of *Olpidiopsis* and *Rozella* as suddenly forming rounded spores. In the former case he writes: "Mit einem male zerfällt das gesammte Inhalt in scharf umschriebene rundliche Theilchen. . . ." In the latter case he states: "Plötzlich zerfällt nun in einem gegebenen momente das Protoplasma in eine menge rund umschriebenen Portionen die zukünftigen Zoosporen." Pringsheim (43–45) regards the spore formation as occurring "unmittelbar" (directly) in *Achlya prolifera, Olpidiopsis, Rozella,* and *Woronina.*

Strasburger (48) was perhaps the first to use the term, simul-

taneous, as describing spore formation: "In den Zoosporangien der Saprolegnien wird, wie aus zahlreichen angaben bekannt, eine grosse Anzahl Schwarmsporen simultan aus dem gesammten Protoplasmatischen Inhalte des sporangium gebildet."

Dangeard (14), studying spore formation in *Synchytrium taraxaci,* calls it simultaneous fragmentation. Popta (42), who was concerned with the question of periplasm and spore formation in the so-called Hemiasci, refers to spore production in *Protomyces bellides* as "Simultan und sehr rasch." Barrett (3), investigating some species of *Olpidiopsis,* states that segmentation of the sporangial contents is apparently simultaneous throughout.

Cornu (12), studying the Chytridiales, parasitic on Saprolegniales, refers to spore formation in *Olpidiopsis* as follows: "Presque sans transition, le contenu s'organise en petites masses spheriques, futures zoospores." He claims that a similar phenomenon occurs in the sporangia of *Rozella* and *Woronina.* Thus in the above-mentioned genera the spore plasm is said to organize, with practically no transitional stages, into spherical masses.

Büsgen, who, as already mentioned, made a comparative study of a number of Saprolegniales, Peronosporales, and Mucorales, combines the conceptions of cell-plates and division, not always simultaneous. He says: "Unter auftreten von Zellplatten theilt sich der gesammte Inhalt des Sporangiums—nicht immer simultan—in etwa gleich grosse, meist nicht regelmässig begrenzte Portionen. . . ."

Rothert (46), in a quite thorough piece of work on *Saprolegnia,* figured clefts from the central vacuole proceeding outward. Humphrey (29), studying the Saprolegniales of America, merely states his agreement with Rothert as to cleavage and spore formation.

Thaxter (51) finds spore formation simultaneous in *Syncephalastrum,* but occurring by progressive constriction in *Syncephalis pycnosperma, S. nodosa, S. Wynneae, S. cordata,* and in a *Syncephalis* closely allied to the latter.

Kusano (32) and Griggs (23) hold that spore formation in *Synchytrium puerariae* and *Rhodochytrium,* respectively, may be either simultaneous or progressive. Davis (15), studying spore formation in the sporangia of *Saprolegnia,* Wager (58) in *Poly-*

phagus Euglenae, and Butler (9) in *Pseudolpidium aphanomycis* record spore formation as proceeding from the center to the periphery by cleavage, but do not refer to it as progressive. Likewise, Hartog (27), investigating *Pseudospora Lindstedii,* a monadine parasitic on *Saprolegnia,* figures cleavage by vacuoles extending to the periphery of the protoplasmic mass, but does not refer to it as progressive. Davis (16) figures progressive cleavage in the sporangia of the alga, *Derbesia,* by means of furrows starting from the periphery and proceeding inward. Loewenthal (35) has studied spore formation in *Olpidium dicksonii* and *Zygorhizidium willei* and Griggs (22) has studied *Monochytrium,* but both authors leave the question unsettled whether the cleavage is progressive or simultaneous.

In 1899, Harper (24), studying cell-division in sporangia and asci, pointed out that in the sporangia of *Synchytrium decipiens* the cleavage is accomplished by furrows, which form on the surface of the initial cell, and by growing deeper in a more or less radial fashion divide the protoplasmic mass, successively, into smaller portions. Harper also investigated the spore and columella formation in *Pilobolus crystallinus* and *Sporodinia grandis.* He finds, as Brefeld had stated, that the columella is not first a plane wall, which is eventually pushed up into the sporangium, but that it is from the first dome-shaped, a layer of vacuoles appears near the inner boundary of the dense spore plasma, which subsequently flatten and fuse and thus delimit the spore plasma from the columella plasma. In the case of *Pilobolus* the columella formation is aided by cleavage furrows cutting in at the base of the sporangium.

In *Pilobolus,* as in *Synchytrium decipiens,* the cleavage is progressive and is initiated by the formation of surface furrows which deepen and finally cut the plasma into protospores. In *Synchytrium decipiens* the uninucleated protospores become multinucleated and enlarge to form the spores which in germination again become sporangia. In *Pilobolus* the progressive cleavage leads to the formation of one or few nucleated protospores. These protospores become multinucleated, increase in size, and divide until finally oblong, binucleate sporangiospores are produced. In *Sporodinia,* Harper finds an abbreviated process of spore formation in that the

progressive cleavage, by surface furrows and clefts, divides the spore plasm into multinucleated, polygonal blocks of very variable size which round up at once and become the definitive spores.

Swingle (50) finds cleavage in the sporangia of *Rhizopus nigricans* much like that in *Sporodinia*, except that the spores are more uniform in size and have thicker walls. In *Phycomyces* the spore plasm is divided by vacuoles, which become angular and fuse to form irregular clefts. Spore formation is aided by furrows which cut into the spore plasm from the columella cleft. Swingle agrees with Harper as to the method of columella formation.

Timberlake (52) describes spore formation in the sporangia of the alga, *Hydrodictyon*, as a progressive cleavage by means of furrows. Percival (41) and Rytz (47), discussing spore formation in *Synchytrium endobioticum* and *Synchytrium succissae*, respectively, both agree that spore formation is brought about by progressive cleavage.

In 1913, Moreau (37) described the spore formation in a number of Zygomycetes. His study may be summarized as follows: In *Circinella conica* spore formation proceeds by means of vacuoles, which separate fragments of protoplasm having the form of amoebae. The protoplasm contracts around each nucleus, rarely around two nuclei, forming protospores which he compares to those described by Harper for *Pilobolus*. The nuclei then divide and lead to the formation of multinucleated spores. Moreau states that for *Phycomyces nitens* and *Rhizopus nigricans* his observations agree in general with those of Swingle, but on page 32 he refers to the protoplasmic segments as being "amiboide" and connected by trabeculae. In *Mucor spinescens*, Moreau finds that a confluence of vacuoles leads to the formation of elongated protoplasmic threads. The threads become nodose, each nodosity containing one or two nuclei and finally forming a spore. Moreau states that a similar thread stage may be observed in the spore formation in *Absidia glauca* and *Absidia septata*. In *Syncephalastrum cinereum* and *Syncephalastrum racemosum* the spores are said to be formed by a condensation of protoplasm into spherical or elliptical masses, each enclosing one or more spores; generally there is but one nucleus in each spore. Moreau's description of

spore formation, in the above-mentioned zygomycetes, is extremely fragmentary and certain of his figures suggest that his material was poorly fixed.

METHODS

The *Saprolegnias* were grown on small flies of the genus *Drosophila.* They were frequently parasitized by *Olpidiopsis* and *Rozella.* Cultures on the flies were then transferred to slightly cooled agar plates. A drop of water was then placed on each fly so that the sporangiferous filaments might float out into their normal position. Slightly cooled agar was then gently dropped over each fly. The cultures were then exposed out-of-doors to quickly congeal the agar. The halo of filaments was still easily discernible. Blocks of agar containing the entire host were now cut out and transferred to weak Flemming and Merkel fixatives. The washing, dehydrating, and imbedding was done as usual. The sections were cut 5 μ thick, stained with the Flemming triple combination, cleared very quickly in clove oil, and mounted in Canada balsam.

Cleavage in *Saprolegnia* was also studied in hanging-drop cultures, and *Olpidiopsis* was also studied in the same manner. The Zygomycetes were cultured upon sterilized bread in jelly glasses. In order to retain the loose, open structure of the bread, which facilitates the growth of the mycelia, only a small amount of water was poured into each jelly glass before sterilization. When the sporangia assumed a snow-white appearance, under the hand-lens, wefts of the fungus were cut out with sharp-pointed scissors and immediately transferred to the fixatives. The conglomerated mass of hyphae was then gently pushed down into the fixative and the vial was shaken to dislodge the air-bubbles. The material was fixed for 24–48 hours in Merkel's solution, or for one hour in one part of weak Flemming and two parts of water, and then transferred to Merkel's fixative. By these means blackening of the fungus was prevented and bleaching with hydrogen peroxide was unnecessary.

The fixative was now poured off and the vial was carefully filled with water and tilted into a dish of water. The fungus was repeatedly floated into a vial and transferred into fresh water. The material, thus washed for two to two and one half hours, was

then dehydrated, beginning with 15% alcohol, and imbedded in paraffin. The sections were cut 5 μ thick, stained by Flemming's triple method, cleared quickly in clove oil, and mounted as usual.

OLPIDIOPSIS

Pringsheim (45) gave us the first account of spore formation in the sporangia of *Olpidiopsis*, a parasite, which he mistook for the antheridia of *Saprolegnia*. He speaks of the spores as "Samenkörper" and says that they are formed directly (unmittelbar), and that similar phenomena may be observed in the structures which we now recognize as the sporangia of *Rozella* and *Woronina*.

In 1872, Cornu (12) published a paper in which he supported A. Braun (6) in reference to the parasitic nature of *Olpidiopsis*. He noted the appearance of large centrally disposed vacuoles, their disappearance, and the formation of a foamy protoplasm. Both Cornu (12) and Fisher (19) agree that the spores are formed directly.

Maurizio (36) states that cell-plates are formed in spore formation in *Olpidiopsis major*. As already mentioned, Loewenthal is not clear as to whether spore formation in *Olpidium dicksonii* and *Zygorhizidium willei* is simultaneous or by progressive cleavage.

In Butler's (9) account of spore formation in *Pseudolpidium aphanomycis* he states that the spore "Anlage" originate as a result of "heapings of protoplasm," which are few in number as compared with the number of zoöspores produced. Butler compares this stage with that Harper describes in *Synchytrium*, where the early stages of cleavage give rise to multinucleated masses of protoplasm. Cleavage fissures then extend from the vacuole to the sporangial wall, the vacuolar and protoplasmic membranes then rupture, and the "Anlage" swell and fuse. The sporangium is now filled with a homogeneous mass. Butler states: "Five or ten minutes later final fashioning of the zoospores is complete and movement commences in the sporangium." Butler records cleavage furrows extending from the vacuole to the sporangium wall, but he does not figure them. His figure 6*C*, plate 9, which he interprets as a "condensation of protoplasm into heaped masses,"

appears to be a stage prior to the enlargement and fusion of the vacuoles into a large central vacuole.

Barrett (3) studied both living and stained material of a number of *Olpidiopsis* species. He reports that he could not detect any signs of the protoplasmic heapings described by Butler within the sporangium. If one studies the figures in plate 24, one is led to believe that Barrett did not find the crucial stages of spore formation. This leads him to the erroneous conclusion that "fragmentation of the protoplasm is simultaneous."

Kusano (33) investigated the life history and cytology of *Olpidium viciae*. He was unable to find evidence of progressive division, but states "that a clear space appeared in the cytoplasm all at once between each two nuclei, and that the protoplasm was cut up into as many polygonal parts as there were nuclei." It seems obvious that this statement refers to the stage following what Strasburger and Büsgen regarded as a stage of coalescence of the spore origins which is not real, but only apparent.

The stages in the life history of *Olpidiopsis saprolegniae*, prior to the formation of spores, have been discussed and figured by a number of authors. From a study of the living material, in hanging-drop cultures, I am able to confirm the existence of large centrally disposed vacuoles in young sporangia, the increment in size, and subsequent coalescence of these vacuoles. The process of spore formation, as I have observed it, is entirely at variance with that described by the above-mentioned authors. The phenomena I observed were very similar to processes of spore formation in the sporangia of *Saprolegnia* and *Achlya* as I have found them and not as described by Strasburger, Büsgen, and Hartog. I was able to note the following changes by observing living specimens in hanging-drop cultures. The history of one sporange is as follows:

At 7:40 P.M. the sporange had a large central vacuole, and in the median plane a blunt cleavage furrow could be seen extending toward the periphery (text fig. A, 4). Three minutes later the vacuole became irregular and one sharp and two blunt cleavage furrows were visible (text fig. A, 5). Four minutes later the vacuole had increased in size so that the protoplasm formed a rather thin peripheral layer. Sharp cleavage furrows were now

evident (text fig. A, 6, 7), and after the elapse of one minute they cut through the latter and the large vacuole disappeared. Cleavage is now complete and here and there the outlines of the spores can be made out (text fig. A, 8). After two minutes the protoplasm became very granular and the hazy outlines of polygonal spore masses were recognizable. I can only interpret this polygonal stage as due to rapid growth of the spore initials, which thus press against one another and become polyhedral. One minute after the appearance of the compact, polygonal spore initials a contraction occurred, the inter-sporal substance appearing as hyaline lines.

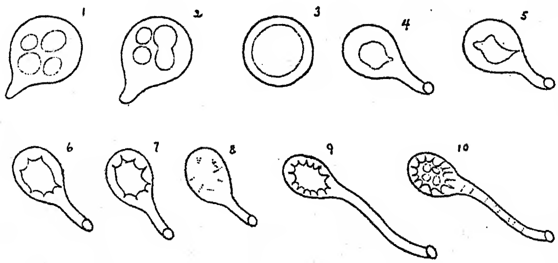

Fig. A. *Olpidiopsis saprolegniae:* 1–2, median view of sporangia showing several rounded vacuoles; 3, sporangium showing coalescence of the vacuoles; 4–8, different series than 1–3 in which the wall layer is thinner; 4–5, sporangia showing vacuoles of various shapes; 6–7, sporangia showing early cleavage stages; 8, sporangium showing apparent homogeneous stage following the rupture of the plasma membrane; 9-10, another individual, sporangia show radial furrows; 10, cleavage has occurred in the exit tube. 1–2 and 4–10 show exit tubes.

One minute later the spores underwent a further contraction; they rounded up and almost immediately began to move to and fro. Within two minutes the zoöspores escaped through the exit tube. Thus within eighteen minutes of the first formation of a cleavage furrow the spores formed and escaped. If one considers the rapidity of these changes, one can readily infer why the cleavage furrows, extending outward from a central vacuole, are so seldom seen in fixed sections. I can not agree, therefore, with Barrett that the spore formation occurs simultaneously. I would interpret his figure 39 as a contraction stage following the so-called homogeneous state, of Strasburger and Büsgen, in which the spore initials are so closely pressed together that their boundaries are

almost obliterated. Nor can I agree with Butler, who describes the formation of "protoplasmic heapings" and the delimitation of multinucleated, protoplasmic masses, which are later cut up by cleavage furrows, to form the spore origins. In no case did I observe any fusion of spore initials and the resulting production of a homogeneous state such as Butler describes for *Pseudolpidium aphanomycis* and as was held by Strasburger and Büsgen to occur in *Saprolegnia*.

We can summarize, roughly, the following stages in the spore formation of *Olpidiopsis saprolegniae* Cornu:

1. Protoplasm with many small vacuoles.
2. The formation of large vacuoles more or less centrally disposed and the concomitant production of an exit-tube.
3. The coalescence of large vacuoles into a large central vacuole.
4. Progressive cleavage by furrows cutting outward from the central vacuole. (First contraction phase.)
5. Cleavage of plasma membrane, shrinkage of the sporangium and disappearance of the central vacuole.
6. Swelling of the spore initials to the polygonal closely pressed areas commonly observed.
7. Second contraction phase—appearance of hyaline spaces between spore initials (often erroneously interpreted as cell plates).
8. Further contraction leading to the rounding up of the spore masses and their swarming movements.

The above conclusions were reached after carefully studying the cleavage phenomena in dozens of sporangia in hanging-drop cultures.

SAPROLEGNIA AND ACHLYA

Rothert (46) recognized three types of sporangia in the Saprolegniaceae: "gefüllte Sporangien," those completely filled with protoplasm; "inhaltsarme," those having a thin parietal layer of protoplasm; and "normale," sporangia with a thick parietal layer, the predominant form. Rothert figured furrows cutting through the protoplasm from the central vacuole outward and notes that these furrows appear practically simultaneously throughout the whole length of the sporangium. Rothert's observations on spore formation in *Saprolegnia* and *Achlya* are of great importance for understanding the cleavage phenomena in the other sporangia. Harper has reviewed and confirmed Rothert's observations in sev-

eral points, but recent students have in a number of cases failed to take account of the evidence he has presented as to the contraction and expansion phases accompanying cleavage. I have studied *Achlya* and *Saprolegnia* in both living, sectioned, and stained material, and my observations confirm those of Rothert.

The process of cleavage is similar to that I have already described for *Olpidiopsis saprolegniae*. The cleavage is progressive, the furrows appear first on the inner surface of the parietal protoplasmic layer and give the latter an undulated appearance. Gradually these clefts become sharper and reach the plasma membrane. In optical view these protoplasmic masses resemble the old-fashioned sugar-loaves. Viewed from the surface the protoplasmic masses are roughly polygonal. The spore initials are generally described as being connected by fine protoplasmic strands. I am inclined to interpret these strands as gelatinous exudates of the spore initials. Rothert described the development of spores in very slender sporangia as a heaping of protoplasm on the protoplasmic membrane. It is a question whether there is much, if any, increase in the radial diameter of the protoplasmic layer on the median axis of the spore initials. A better interpretation of the spore formation in these sporangia and in the oögonia is to regard it as a process of cleavage, the furrows being at first broad and shallow instead of sharp and deep.

The spore initials now contract and the clefts become prominent. The protoplasmic masses now become densely granular, are highly refractive, and assume more definite outlines. This stage is quickly followed by a splitting of the protoplasmic membrane which is drawn in by the isolated spore initials as they round up. Division of the protoplasmic content is now complete, each definitive spore is uninucleated and is homologous with the uninucleated protospores Harper described in *Synchytrium decipiens*.

As first noted by Rothert and confirmed by Harper, the splitting of the elastically stretched plasma membrane is attended with a marked shrinkage of the sporangium wall accompanied by the expulsion of part of the cell-sap through the sporangial wall. The basal septum, which has heretofore been concave, is now pushed up by turgor into the sporangium and assumes a convex configura-

tion. Rothert estimated the shrinkage at 13 per cent. Butler (9) finds that at a corresponding stage the diameter of the sporangium of *Pythium intermedium* decreased by about one tenth. The same author also noted a contraction of the sporangium of *Pseudolpidium aphanomycis* immediately after the disappearance of the large central vacuole. Harper called attention to the fact that in *Synchytrium decipiens* the cleavage was accompanied by pronounced shrinkage. He found that when cleavage was complete the total volume of the segments had been reduced to such an extent as not to occupy more than approximately one third of the volume of the primordial cell. Kusano also reports a shrinkage of the segments in the sporangia of *Synchytrium puerariae* during the cleavage process.

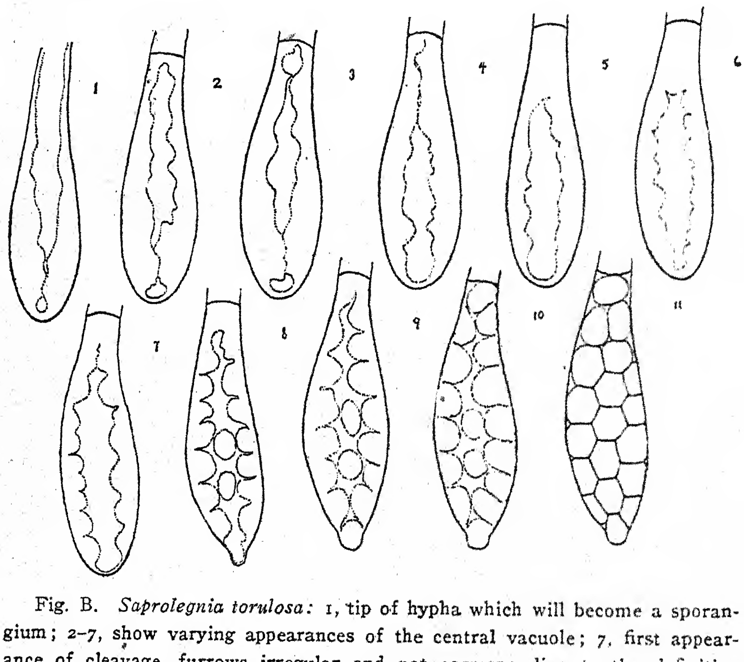

Fig. B. *Saprolegnia torulosa:* 1, tip of hypha which will become a sporangium; 2–7, show varying appearances of the central vacuole; 7, first appearance of cleavage, furrows irregular and not corresponding to the definitive furrows; 8–9, spore masses outlined by rather shallow furrows, the two oval outlines in these figures, and also in figures 10, represent the end views of spore initials projecting up from below; 10, clefts have become deeper; 11, spores have become polygonal through mutual pressure; this stage soon follows the rupture of the plasma membrane and represents an expansion phase of the spores; the basal wall is now convex toward the sporangium showing that its plasma membrane is ruptured.

Text figure B, 1–11, represents the lengths and breadths of a sporange at successive stages in spore formation. The micrometer measurements are as follows:

9:12 P.M.	86 μ long—26 μ wide
9:27 P.M.	88 μ long—26 μ wide
9:37 P.M.	90 μ long—25 μ wide
9:56 P.M.	92 μ long—25 μ wide
10:05 P.M.	93 μ long—25 μ wide
10:10 P.M.	94 μ long—28 μ wide
10:17 P.M.	90 μ long—27 μ wide
10:22 P.M.	92 μ long—26 μ wide
10:30 P.M.	86 μ long—22 μ wide
10:34 P.M.	Spores moved to and fro.

At 10:10 P.M. the sporange had reached its maximum size; the basal wall was concave, due to the turgor within the sporange. At 10:17 P.M. the clefts apparently cut through the plasm membrane, the spore initials rounded up, and the sporange decreased four microns in length and one micron in diameter. The basal wall was now flattened. This stage of contraction was followed by the expansion stage. The spore initials became tightly pressed together, the protoplasm assumed a homogeneous appearance, and the spore outlines were only visible as very faint lines. This is the stage that deceived Strasburger (48), for he writes as follows: "Wiederholt sind mir Fälle vorgekommen in welchen nach dem die Sporenanlage es schon bis zur Bildung der Körnergrenzen ja selbst Hautschictgrenzen gebracht hatte, plötzlich die ganze Entwickelung rückgängig wurde, alle Trenungsandeutungen schwanden und das Sporangium alsbald wieder von gleichmässig kammerigen Protoplasm gefüllt erschien. Dann nach kurzer Zeit, wurde die Entwickelung, und zwar nun auffallend schnell wieder aufgenommen. Eine solche zweite fiel mir, im Verhältniss zu der Ersten stets durch die grosse Regelmässigkeit der Theilstücke auf."

The great expansion following the delimitation of the spore initials, the temporary loss of the granular character of the spore protoplasm, the obscuring of the cell boundaries through close contact, and the subsequent contraction which reveals the polygonal spore masses have given rise to much confusion. Butler (9), in 1907, speaking of spore formation in *Pythium proliferum*, writes: "From this I have been led to suppose that even at this stage the

spore origins are definitely formed, and that, though fused into a mass in which individual spores can not be made out, yet each nucleus has obtained a hold on a certain mass of cytoplasm. . . ."

The sudden appearance of the polygonal spore masses at the beginning of the second contraction phase has given rise to such theories as the simultaneous cleavage of the sporangial protoplasm into polygonal masses and the cutting out of the spores by cell-plates. I have already summarized these views and I need not repeat them here.

The polygonal spores of *Saprolegnia* undergo a further contraction and subsequently round up. The turgor in the sporangium is decreased to such an extent that the basal wall now becomes convex inward. At this stage the sporangium decreased still more in length. Thus during the period of greatest turgidity the sporangium measured 94 microns in length. When the spores were fully matured the sporangium had contracted eight microns in length and six microns in width.

The observations of Rothert (46) relative to the escape of the cell-sap and the concomitant shrinking of the sporangium during spore formation in *Saprolegnia*, Harper's evidence of similar phenomena in *Synchytrium decipiens*, Kusano's observation of shrinkage in *Synchytrium puerariae*, Swingle's account of progressive cleavage in *Rhizopus nigricans* and *Phycomyces nitens*, Harper's studies of spore formation in the sporangia of *Sporodinia grandis* and *Pilobolus*, Butler's observations relative to shrinkage in the sporangia of *Pythium intermedium* and *Pseudolpidium aphanomycis*, Harper's and Dodge's observations of the extrusion of water into vacuoles during the early stages of the formation of sporangia in *Trichia*, as well as my own observations, lead me to corroborate the contention of Harper that the exudation of water is a factor in the process of segmentation of the protoplasm. Harper compares the furrowing of the spore plasm with the cracking of a drying, colloidal mass. The fact that vacuoles or furrows never cut out protoplasmic segments devoid of nuclei is proof that the latter are the centers which control the water loss and thus the cleavage process. This may be explained by assuming that the nucleic acids manifest an attraction or affinity for water greater

than that displayed by the cytoplasm; hence, as Harper has suggested, the loss of water may be least in the vicinity of the nuclei.

SPORODINIA GRANDIS

Spore formation in the sporangia of *Sporodinia grandis* was regarded by both Van Tieghem (55) and Leger (34) as a condensation of the spore plasm into polyhedric masses, which later round up. Harper (24) has figured a number of stages in spore and columella formation. Swingle (50), a few years later, studied the same fungus and reports that his results are entirely in accord with those of Harper.

As *Sporodinia* represents an extreme type as to the speed of spore formation, I have studied the process further in the light of the conceptions of contraction and expansion first developed by Rothert from his studies on the sporangia of *Saprolegnia*. I find the dome formed by series of large vacuoles, which flatten, fuse, end to end, and separate the spore plasm from the columella plasm as described by Harper. I have, however, a number of slides (Pl. 15, figs. 1, 6) which show an interesting variation of the process in that the vacuoles are completely fused on one side of the sporangium, while on the other side they are either somewhat globose or flattened. Swingle's fig. 8, plate 2, shows that in *Rhizopus nigricans* the columella formation may be more advanced on one side of the sporangium. A few times I observed surface furrows cutting in at the base of the sporangium, to meet the flattened vacuoles, which cut out the columella (Pl. 15, fig. 6). Harper has described a similar phenomenon in *Pilobolus* and Swingle in *Rhizopus nigricans*.

In *Sporodinia* spore formation may begin before the columella cleft is complete. Swingle notes that this often occurs in *Rhizopus nigricans* (see his fig. 8, plate 2). This shows, it seems to me, that the columella formation and cleavage are two parts of one general contraction phase. The cleavage is progressive and may begin by the formation of furrows at the surface or at the columella cleft (Pl. 15, figs. 1, 2). It is to be noted that cleavage is more advanced in that region where the fusion of vacuoles has produced the columella cleft (Pl. 15, fig. 6). The furrows cut

inwardly and as the spore plasm is giving off water the clefts widen. The furrows from the surface appear to cut into the spore plasm in a centripetal fashion. They meet and fuse with those furrows which started from the columella cleft and cleavage is thus completed; the protoplasm has been cut up into a mass of irregular blocks which are variable in size and are multinucleate. These spore initials represent, as compared with swarm spores of *Saprolegnia* and the protospores of *Synchytrium decipiens*, *Pilobolus crystallinus*, *Circinella conica*, etc., a premature completion of spore formation. They correspond to the multinucleate masses preceding the protospores. As in *Rhizopus nigricans*, the spores of *Sporodinia grandis* are multinucleate at their inception. When cleavage is complete the spore initials present a dense granular appearance. The protoplasmic mass is also somewhat shrunken. Soon, however, the spore initials take up water and grow, the protoplasm becomes less granular and takes on a lighter stain. The spores become so tightly pressed together that their protoplasmic membranes assume polyhedral outlines, which are so thin that they are traced with difficulty under the oil-immersion objective (Pl. 15, fig. 4). This stage is homologous with the so-called homogeneous stage, which Strasburger and Büsgen described for *Saprolegnia*. This period of growth is followed by a second contraction. The spores now develop a thin wall, contract slightly, and round up.

I have illustrated the chief stages of the development of the columella and spores in *Sporodinia grandis* in a series of text figures (text fig. C, 1–5).

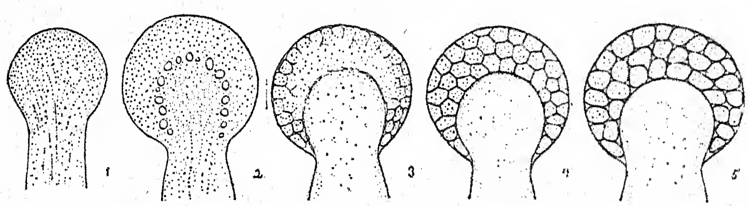

Fig. C. Diagrams showing the method of the columella and spore formation in *Sporodinia grandis*, the nuclei appearing as mere dots. 1, a young sporangium. 2, showing the dome-shaped layer of vacuoles outlining the columella. 3, showing early stage of progressive cleavage. 4, showing the polyhedral stage. 5, mature spores.

MUCOR RACEMOSUS

Apparently no one since Leger (34) has studied spore formation in *Mucor racemosus*. Leger claims for it, as for all sporangia, that the spores are cut out simultaneously as polyhedric blocks.

Moreau (37) has studied *Mucor spinescens* and he describes vacuolization of the protoplasm resulting in long strands, which become nodular and then break up into uninucleate or several nucleated spores. He gives no further account of the process.

I have studied *Mucor racemosus* relative to the process of spore formation. I find that spore formation is initiated by furrows, which start as the periphery of the spore plasm and cut out multinucleated blocks of irregular size (Pl. 16, fig. 16). Further furrowing cuts up these blocks into irregular protoplasmic masses containing a few nuclei. These protoplasmic masses then grow and become polyhedral. This expansion stage is followed by a second contraction, the spores round up and develop a cell-wall. The mature spores may contain seven to eight nuclei. I have not observed a protospore stage. The process of spore formation, as in *Sporodinia grandis,* is abbreviated, but the spores have thicker walls and are viable for a longer period. They are also more uniform in size than those of *Sporodinia grandis.*

CIRCINELLA MINOR

Moreau (37), studying spore formation in *Circinella conica,* states that the center of the sporangium is at times occupied by a large vacuole. The formation of spores is accomplished by irregular vacuoles, which cut up the spore plasm into amoeba-like bodies bound together by protoplasmic strands. These strands become thinner and break, the protoplasm then contracts about each nucleus, rarely around two. Moreau compares these protoplasmic bodies to the protospores Harper described in *Pilobolus crystallinus.* The nucleus then divides and each protoplasmic mass becomes multinucleated, the spores become polygonal and press against one another. At maturity they become globular and smooth.

I have studied spore formation in *Circinella minor,* but my observations do not agree entirely with those of Moreau. Cleavage,

as I have observed it, is similar to that Harper described in *Pilobolus*. Furrows appear at the surface of the spore plasm and cut inwardly to meet the clefts produced in the interior of the spore plasm by vacuoles, which become angular (Pl. 16, fig. 8). The spore plasm is thus cut up into irregular protoplasmic blocks containing a variable number of very small nuclei (Pl. 16, fig. 8). Moreau does not describe or figure cleavage furrows in *Circinella conica*. The irregular blocks are further divided by cleavage into more or less oblong to sausage-shaped protoplasmic masses containing four to five nuclei (Pl. 16, fig. 9). As in *Pilobolus*, these blocks are transversely divided into roughly polygonal, one- to two-nucleated protoplasmic masses. I agree with Moreau in calling these protoplasmic segments the protospores. During the cleavage process the protoplasmic mass undergoes shrinkage without question, but I did not observe such a loose and open structure of the dividing spore plasm as Moreau figures, and I am inclined to believe that his figure 28, plate 3, represents poor fixation and considerable shrinkage. The protospores are, for a time, connected by delicate, gelatinous strands, which are probably an exudate of the protoplasm (Pl. 16, fig. 10). The nuclei now divide and each protoplasmic mass (protospore) swells and grows. The young spores now become polyhedral and are closely pressed together (Pl. 16, fig. 13). This expansion period is followed by a contraction; the multinucleated spores round up and form a cell-wall (Pl. 16, fig. 14).

The process of spore formation in *Circinella minor* may be summarized as follows:

1. Differentiation of spore and columella plasm.
2. Formation of irregular multinucleate blocks of protoplasm by surface furrows and angular vacuoles.
3. Further division by cleavage producing oblong protoplasmic masses containing four to five nuclei (2 and 3 are contraction phases).
4. Division of oblong to sausage-shaped blocks into one- to two-nucleated protospores.
5. Protospores grow and become multinucleated (expansion phase).
6. Spores round up (second contraction phase).
7. Further contraction and formation of cell-walls.

Harper has pointed out that in *Sporodinia grandis* there is an abbreviation of the process of spore formation as compared with

Pilobolus crystallinus and *Synchytrium decipiens.* It is evident that the process of spore formation in *Circinella minor,* like *Rhizopus nigricans,* occupies an intermediate position in such a series. In *Circinella minor* the formation of protospores is followed by nuclear division and growth. But with the formation of the protospores cell-division is complete. In *Pilobolus crystallinus* the protospore grows and becomes multinucleated, but this multinucleated cell divides by constriction. The final cell-divisions produce the oblong, binucleate spores. In *Sporodinia grandis* the process of spore formation is so abbreviated that the initial cleavage cuts out comparatively large multinucleated segments which ultimately round up and become the definitive spores.

I have illustrated the chief stages of the development of the columella and spores in *Mucor mucedo* in a series of text figures (text fig. D, 1–5).

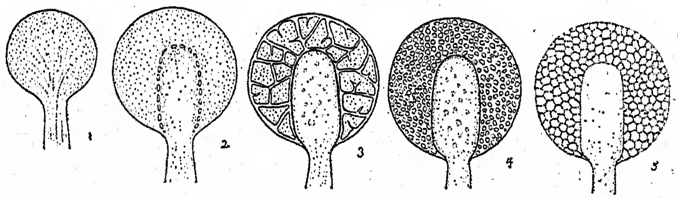

Fig. D. Diagrams showing the method of the columella and spore formation in *Mucor mucedo.* 1, a young sporangium. 2, showing the dome-shaped layer of vacuoles outlining the columella. 3, showing the spore plasm cut up into protoplasmic blocks by progressive cleavage. 4, spore-initials in the contraction stage. 5, showing the polyhedral or expansion stage.

MUCOR MUCEDO

Strasburger (49) has given us a fragmentary account of spore formation in *Mucor mucedo.* He considered the protoplasmic mass cut up by cell-plates in a manner similar to that in *Saprolegnia.* Two years later Büsgen (8), studying the same species, came to the conclusion that the spore plasm is cut up into large protoplasmic blocks by cell-plates, and that by subsequent subdivision protoplasmic masses are formed which have the size of the definitive spores. The sporangium then becomes homogeneous and a *second division* produces the definitive spores. Leger (34) studied spore formation in the sporangia of *Mucor mucedo* and

agrees with Van Tieghem that the spore plasm is divided at once into polyhedric granular spores separated by a non-granular substance. Moreau,[1] studying spore formation in *Mucor mucedo,* came to the conclusion that the spore plasm divides into irregular multinucleated fragments which subsequently become the spores.

I have studied the method of the columella and spore formation in *M. mucedo.* I find that the columella does not originate as a plane wall, which is subsequently arched up into the sporangium, as is so often depicted in textbooks on botany, but that as in the Zygomycetes studied by Harper (24) and Swingle (50) the columella is from the first dome-shaped as I show in Pl. 16, fig. 19; a dome-shaped series of vacuoles appear, these flatten, fuse end to end, and thus delimit the spore plasm from the columella plasm.

The spore plasm is first cut up into comparatively large protoplasmic blocks. During this stage considerable contraction occurs for the blocks are not in close apposition (Pl. 16, fig. 20). These blocks are now subdivided by cleavage into roughly polyhedral spore initials. This subdivision is attended by still further contraction, followed by an expansion stage in which the spore initials become polygonal, as figured by Leger ((34), plate 8, fig. 35; my figure, plate 16, fig. 21). These spore initials eventually contract and form the ovate definitive spores. I have not been able to determine with certainty the number of nuclei in the ripe spores.

RHIZOPUS NIGRICANS AND PILOBOLUS CRYSTALLINUS

The process of spore formation in *Sporodinia grandis* is much abbreviated, the spore plasm being cut up only into relatively large multinucleate blocks (text fig. C, 1–5), which quickly round up to form the definitive spores. In *Rhizopus nigricans* (text fig. E, 1–5) the spore plasm is cut up, progressively, into numerous much smaller multinucleate, angular to ovate spores, but never reaches the uninucleate stage. The relative extent of the cleavage is well illustrated by comparing the size of the spores of *Rhizopus nigricans* with that of those of *Sporodinia grandis.* In *Sporodinia grandis* the spores measure, on an average, 20–30 x 17–24 μ, in *Rhizopus nigricans* 9–12 x 7.5–8 μ. In *Pilobolus crystallinus* (text fig. F, 1–6) the process of spore formation is still further

[1] Bull. Soc. Mycol. Fr. 31: 71–72. 1915.

protracted. The spore plasm is cut up, by progressive cleavage, into uninucleate protospores. An embryonic stage now intervenes, the protospores grow and become multinucleate. By a series of divisions binucleate definitive spores are produced.

For the sake of comparison I have also included diagrams of *Rhizopus nigricans* and *Pilobolus crystallinus,* showing stages of the development of the columella and spores.

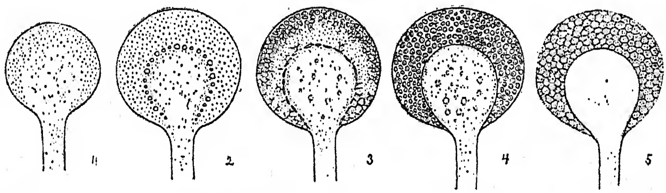

Fig. E. Diagrams showing the method of the columella and spore formation in *Rhizopus nigricans*. 1, a young sporangium. 2, showing the dome-shaped layer of vacuoles outlining the columella. 3, showing early stage of cleavage. 4, showing the contraction stage. 5, expansion or polyhedral stage.

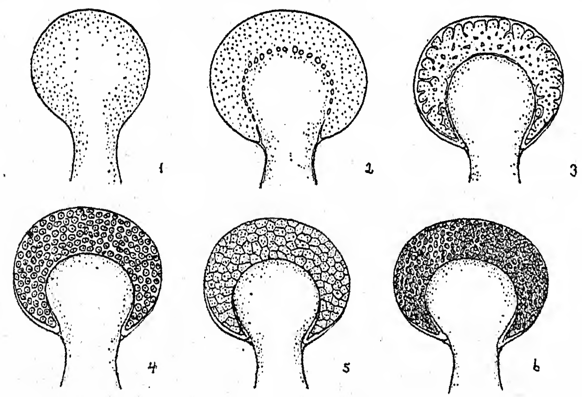

Fig. F. Diagrams showing the method of the columella and spore formation in *Pilobolus crystallinus*. 1, a young sporangium showing dense spore plasm. 2, showing the dome-shaped series of vacuoles and a circular furrow which cut out the columella. 4, stage of uninucleate protospores. 5, polyhedral stage. 6, ripe spore stage.

DISCUSSION

Although a number of recent papers by Kusano (32), Barrett (3), and Griggs (23) report the occurrence of simultaneous cleavage in the sporangia of certain algae and fungi, the evidence to

prove the existence of this method of spore formation is inadequate. On the other hand, there is an accumulation of evidence which confirms the contention that cell-division in the sporangia of algae and fungi is essentially a process of furrowing either from the periphery of the sporangia or from the vacuoles in the interior of the spore plasm.

As far as I am aware Rothert, studying spore formation in the sporangia of *Achlya* and *Saprolegnia*, was the first to note the contraction and expansion phases during the cleavage process. His observations are, therefore, of paramount importance for understanding the mechanics of the cleavage phenomena in other sporangia.

A complete parallelism with the phenomena described by Rothert is found in the process of oösphere formation in *Vaucheria*, as described very carefully from living material by Oltmanns (39). Oltmanns confirms and amplifies the observations of Thuret, relative to zoöspore formation in *Vaucheria*, and Strasburger and Berthold, who studied the process of zoöspore and oögonium formation.

According to Oltmanns, just before the cell-division, which cuts off the oögonium from the parent filament, there is an extrusion of water from the protoplasmic mass within the oögonium; the extruded water forms a large vacuole at or below the base of the oögonium (figs. 8–10, pl. 6–7). This stage is comparable to the first contraction phase with its large central vacuole and the formation of radial furrows beginning the delimitation of the spores, as noted by Rothert in *Saprolegnia*. In the case of *Vaucheria*, cutting off of the oögonium is first initiated by what may be called the cleavage vacuole. The condition is similar to that found in columella formation in *Pilobolus crystallinus*, *Rhizopus nigricans*, *Phycomyces nitens*, *Sporodinia grandis*, *Mucor mucedo*, etc. Such basal vacuoles play the same rôle as the cleavage vacuoles which appear in the spore plasm of *Pilobolus*, *Phycomyces*, *Circinella*, etc.

The plasma membrane about the basal vacuole in *Vaucheria* is finally broken, the cell-sap escapes, and the oögonial protoplasm now expands; the basal plasma membrane of the oögonium and the plasma membrane of the filament are brought into close prox-

imity (fig. 9, pls. 6–7). This stage is to be compared also to the stage in the formation of the columella in sporangia of the Zygomycetes where the vacuoles flatten and fuse edge to edge. Later, in *Vaucheria,* a wall is formed between the two membranes and is seen to be convex toward the oögonium (fig. 11, pls. 6–7). The oösphere is now rounded up in the second contraction phase. The protoplasmic mass, which has heretofore conformed to the general outline of the oögonial wall, undergoes contraction until the rather globular or ovoid oösphere is formed. The ripe oösphere contains relatively few chloroplasts, but numerous oil globules, suggesting the chemical condensation processes which have accompanied the extrusion of cell-sap. Such illustrations show clearly that the process of spore formation, whether sexual or asexual, involves rather a marked series of contraction and expansion phases accompanied by metabolic changes in the protoplasm which result, in general, in the formation of reserve food products, but whose fundamental chemical nature is at present little known.

The process of spore formation may be much abbreviated as in *Sporodinia grandis,* whose spores are short lived and contain little reserve material, or it may be protracted as in *Pilobolus crystallinus* and *Synchytrium decipiens,* by the interpolation of an embryonic stage, in which the protospores increase in size, become multinucleated, ripen, form a wall, and enter a period of rest before they germinate by a tube in *Pilobolus* or by zoöspore formation in *Synchytrium.*

Swingle (50) attributes spore formation in sporangia as due to localized contractions of the protoplasm He does not believe that the nuclei directly influence contraction, but states: "The nuclei determine to some extent just what protoplasm shall constitute each individual spore."

Recently Harper (25) has suggested that the loss of water is probably least in the vicinity of the nuclei during the shrinking and condensation of the spore plasm, and that this might be a determining factor in the orientation of the cleavage furrows.

The failure to note the various contraction and expansion phases accompanying the formation of spores in the sporangia of algae and fungi has doubtless led to the erroneous conception of simul-

taneous cleavage as it still persists in the literature of spore formation.

While the method of the columella formation has been studied in relatively few Zygomycetes, the researches by Harper (24), Swingle (50), and myself have shown that the columella is not from the first a plane wall, which is subsequently pushed up into the sporangium, as is so often figured and described in textbooks on botany, but that it originates as a dome-shaped mass of vacuoles at the inner boundary of the spore plasm. Brefeld (7) observed that the columella was from the first dome-shaped. The vacuoles flatten in their radial axes, fuse edge to edge, and thus delimit the spore plasm from the columella plasm. In *Rhizopus nigricans, Pilobolus crystallinus,* and *Sporodinia grandis* a circular furrow cuts upward from the base of the sporangium to meet the cleft formed by the flattened vacuoles.

This work was conducted under the direction of Professor R. A. Harper, to whom I am indebted for valuable advice, many helpful suggestions, and criticisms. I am also indebted to Prof. Blakeslee for cultures.

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EXPLANATION OF PLATES

All figures were drawn with the aid of the camera lucida, and with the Zeiss 1.8 mm. objective, N. A. 1.25; magnification about 1300 diameters.

PLATE 15

Sporodinia grandis

Fig. 1. Median vertical section of a sporangium showing cleavage complete on one side and first appearance of superficial cleavage furrows.

Fig. 2. Median vertical section of a sporangium showing columella-cleft completely formed and furrows passing upward through the spore plasm.

Fig. 3. Tangential section of a sporangium showing an advanced stage of cleavage and a large central mucorin crystal.

Fig. 4. Oblique section of a sporangium, spores have become polygonal by mutual pressure (expansion phase).

Fig. 5. Tangential section of a sporangium representing an early stage of cleavage.

Fig. 6. Median vertical section of a sporangium, columella-cleft and cleavage complete on one side of the sporangium and in an advanced stage on the other side.

PLATE 16

Fig. 7. *Sporodinia grandis.* Tangential section of a sporangium showing advanced stage of cleavage.

Circinella minor

Fig. 8. Tangential section of a sporangium showing branching furrows.

Fig. 9. Horizontal section of a sporangium; spore plasm cut into oblong to sausage-shaped protoplasmic masses which are somewhat concentrically arranged and are undergoing transverse segmentation.

Fig. 10. Section of a portion of a sporangium, protoplasmic masses are being cut up into 1–2 nucleated protospores.

Fig. 11. Vertical median section of a sporangium, somewhat later stage of cleavage than shown in figure 10.

Fig. 12. Oblique section of a sporangium about same stage as the last.

Fig. 13. Spores have become multinucleated and polygonal (expansion phase).

Fig. 14. Mature multinucleated spores.

Mucor racemosus

Fig. 15. Tangential section of a sporangium showing the beginning of two cleavage-furrows.

Fig. 16. Tangential section of a somewhat larger sporangium, the protoplasm is being cut up into irregular blocks.

Fig. 17. Tangential section of a sporangium, the irregular blocks of protoplasm are being cut up into spores, the nuclei are not well shown.

Fig. 18. Mature multinucleate spores.

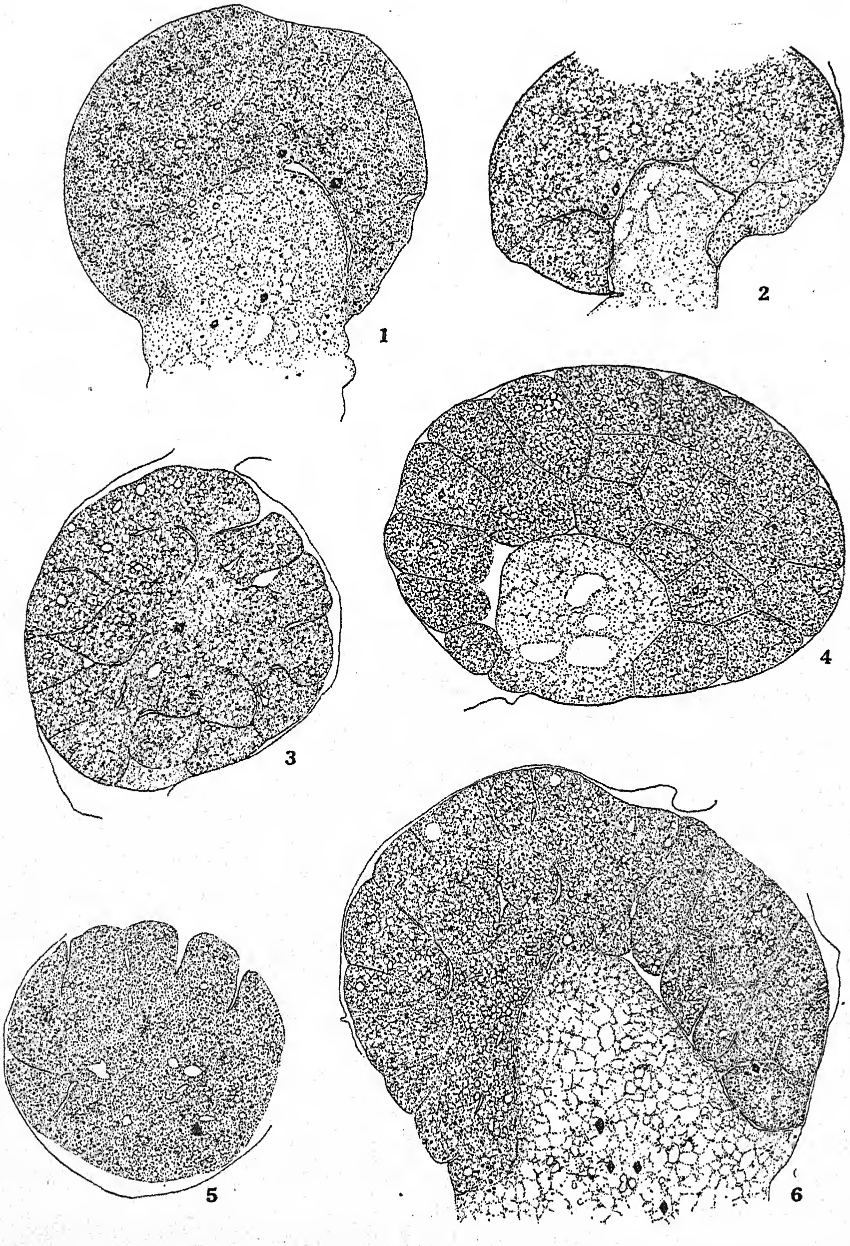
Mucor mucedo

Fig. 19. Median vertical section of a sporangium, columella-cleft nearly complete on one side but in the early stage on the other side.

Fig. 20. Outline drawing of a section of a sporangium showing cleavage of spore-plasm into relatively large protoplasmic blocks.

Fig. 21. Section of a sporangium showing spore-plasm cut up into uninucleate spore-initials.

Fig. 22. Outline drawing of a median vertical section of a small sporangium showing polyhedral spore initials.



SPORODINIA GRANDIS

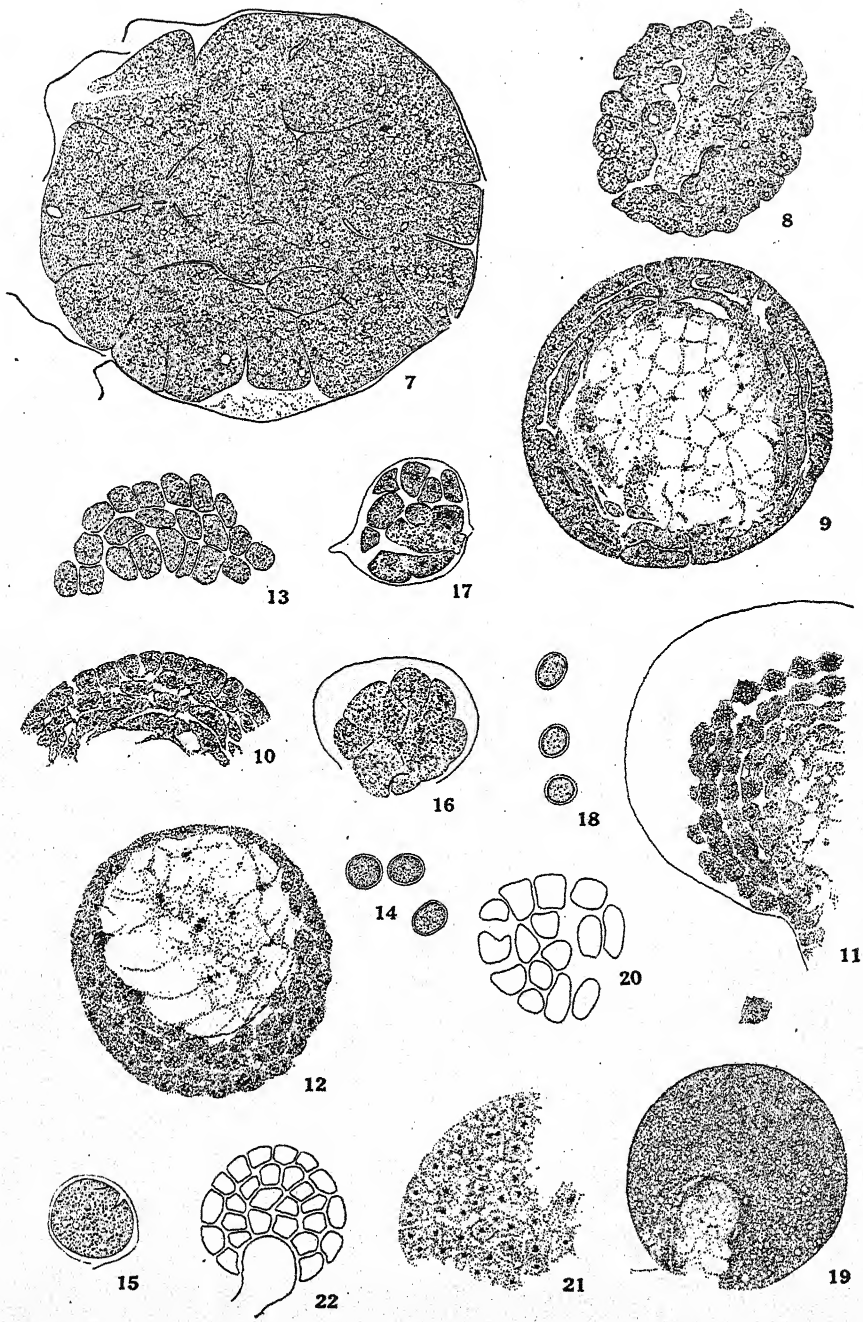


FIG. 7. SPORODINIA GRANDIS
FIG. 8–14. CIRCINELLA MINOR
FIG. 15–18. MUCOR RACEMOSUS
FIG. 19–22. MUCOR MUCEDO

MYCOLOGIA

VOL. XIV JULY, 1922 No. 4

CONTRIBUTIONS TO OUR KNOWLEDGE OF OREGON FUNGI—I

S. M. ZELLER

(WITH 6 FIGURES IN THE TEXT)

The literature dealing with the fungous flora of Oregon has been almost entirely limited to papers on parasitic fungi. Before it is possible to list accurately the fungi of such a relatively unexplored region a great amount of labor is necessary in the preservation of specimens with accurate notes and labels. It is the purpose of the writer to preserve specimens of Oregon fungi as opportunity is afforded and publish from time to time those lists and notes of species which have never been reported from the state or concerning which notes of interest have been obtained. This is the first installment of such lists. In certain groups of fungi many of the determinations were either made or verified by specialists.

Many of the ascomycetous forms were sent to Dr. Fred J. Seaver for identification, or the Oregon specimens were compared with those sent to Dr. Seaver from Seattle, Washington, several years ago. Dr. E. A. Burt has kindly identified most of the Thelephoraceae and many of the polypores. Dr. J. R. Weir and Dr. L. O. Overholts have aided in the determination of some of the polypores, and Dr. C. H. Kauffman and Dr. W. A. Murrill in the determination of some of the Agaricaceae. Many fungi of all groups have been sent to Dr. C. G. Lloyd for comparison. The aid of these men has been greatly appreciated.

The list as given here is in the order of groups and families as given in Saccardo's "Sylloge Fungorum," and colors are given

[MYCOLOGIA for May (14: 99–172) was issued June 6, 1922]

according to the nomenclature established by Ridgway in "Color Standards and Color Nomenclature."

PHYCOMYCETES

1. Family CHYTRIDIACEAE

1. *Urophlyctis pluriannulatus* (B. & C.) Farlow.
In leaves of *Sanicula Menziesii*, west of Corvallis. June. Not infrequent. No. 1825.

ASCOMYCETES

1. Family PERISPORIACEAE

2. *Meliola abietis* (Cooke) Sacc.
This black leaf spot of *Abies grandis* was collected south of Corvallis. August. Infrequent. No. 1850.

2. Family SPHAERIACEAE

3. *Xylaria Longiana* Rehm.
On oak, Corvallis. April. Infrequent. No. 2001.
4. *Daldinia vernicosa* (Schw.) E. & E.
On burned-out trunk of *Quercus Garyana*, Corvallis. April. Rare. No. 2003.
5. *Hypoxylon atropunctatum* (Schw.) E. & E.
On bark of *Quercus Garyana*, Corvallis. April. Common. No. 2000.
6. *Gnomonia Coryli* (Batsch) E. & E.
On lower surface of leaves of *Corylus Californica*, Corvallis. June. Frequent. No. 2013.
7. *Lasiosphaeria strigosa* (A. & S.) E. & E.
On decayed *Alnus* stub, west of Alsea. August. Infrequent. No. 1963.

3. Family HYPOCREACEAE

8. *Nectria episphaeria* (Tode) Fries.
On *Diatrype* on hazel, Corvallis. May. Frequent. Nos. 1953, 1954, 1956.
9. *Nectria Coryli* Fuckel.
On *Salix*, Corvallis. Infrequent. No. 1939. Collected and determined by H. P. Barss.
10. *Nectria galligena* Bres.
Commonly found causing a canker on several varieties of apple and pear and one variety of quince. It has been identified on one native host, *Acer macrophyllum*. This species has been collected in many localities west of the Cascade Mountains. Nos. 1804, 1820, 1823, 1895, 2097, 2098, 2099, 2101, 2103, 2104, 2106–2112, 2174, 2175, 2213.
11. *Nectria coccinea* (Pers.) Fries.
This *Nectria* which resembles *N. galligena* in gross morphology is dis-

tinguished by the character and size of the spores and structure of the perithecium. *Nectria coccinea* has been collected in the vicinity of Corvallis on *Quercus Garyana, Acer circinnatum, Cornus Nuttallii* and *Salix* sp. Nos. 1803, 1938, 2095, 2100.

12. *Pleonectria berolinensis* Sacc.

On old canes of *Ribes,* Corvallis. April. Rare. No. 1925.

4. Family BULGARIACEAE

13. *Stamnaria Persoonii* (Moug.) Fuckel.

On *Equisetum,* Roseburg. Collected by F. H. Lathrop. October. Rare. No. 2031.

Although usually reported as saprophytic it seems to be parasitic in this case.

14. *Bulgaria inquinans* (Pers.) Fries.

On decayed wood, Corvallis. November. Frequent. No. 1980.

5. Family HELOTIACEAE

15. *Phialea alniella* (Nyl.) Sacc.

This little white, stalked discomycete is very common in the spring and makes a striking appearance as it covers the old female cones of *Alnus* which have dropped to the ground.

6. Family PEZIZACEAE

16. *Otidea leporina* (Batsch) Fuckel.

In coniferous woods, Corvallis and Aurora. November. Frequent. Nos. 1874, 2192.

17. *Aleuria aurantia* (Pers.) Fuckel.

Common in lawns and on campus of Oregon Agricultural College, Corvallis. Spring and fall until a freeze. No. 2210.

18. *Geopyxis cupularis* (L.) Sacc.

On ground where brush had been burned. South of Corvallis. April. Frequent.

19. *Discina ancilis* (Pers.) Sacc.

On ground in peach orchards, Kiger Island. April. No. 1910. A very common spring form in the humid portions of the Northwest.

20. *Pseudoplectania melaena* (Fries) Sacc.

On decaying vegetation in mixed forests, on the hills northwest of Corvallis and on Mary's Peak. March and June. Infrequent. No. 2090.

21. *Sarcoscypha coccinea* (Scop.) Sacc.

On decayed coniferous twig, Corvallis. February. Rare. No. 1892.

7. Family HELVELLACEAE

22. *Morchella angusticeps* Peck.

In prune orchard, Kiger Island. April. Frequent. No. 1926.

23. *Morchella crassipes* (Vent.) Pers.

On ground in old orchard, Philomath. April. Infrequent. No. 1924.

24. *Morchella deliciosa* Fries.

On ground in prune orchard, Corvallis. April. Infrequent. No. 1913.

25. *Morchella semilibera* DC.

On ground in prune orchard, Corvallis. April. Infrequent. Nos. 1914, 1916.

26. *Helvella crispa* Fries.

In mixed woods, Corvallis. November. Infrequent. No. 2202.

27. *Helvella elastica* Bull.

On ground in coniferous forest, Corvallis. April. Infrequent. No. 1998.

28. *Helvella lacunosa* Afzel.

On ground in coniferous forest, Corvallis and Mary's Peak. April. No. 1764.

This is the most common species of this order to be found in western Oregon. It appears most profusely in the autumn.

29. *Helvella infula* Schaeff.

On old log of *Pseudotsuga taxifolia*, on the east side of Alsea Mountain. November. Not infrequent. Nos. 1798, 2196.

30. *Gyromitra esculenta* (Pers.) Fries.

Elgin, Union County. April to May. No. 2094.

31. *Spathularia clavata* (Schaeff.) Sacc.

Very plentiful on ground in coniferous woods, Mary's Peak. November. No. 1876.

32. *Trichoglossum hirsutum* (Pers.) Boudier.

In humus in open grassy woodlot north of Corvallis. April. Infrequent. No. 2004.

This collection has uniformly 15-septate spores. The plants are black, 8–10 cm. high and solitary or gregarious.

8. Family TUBERACEAE

33. *Hydnotrya ellipsospora* Gilkey.

Under leaves of *Quercus* and *Pseudotsuga*, Corvallis. March. Rare. No. 1901.

34. *Tuber candidum* Harkness.

On diggings of wood rat under oaks, on campus of McMinnville College, McMinnville. December. This collection (No. 2164) was taken by the writer and identified by Dr. Helen M. Gilkey. This is the most common *Tuber* collected in California within the limited area of Alameda and Placer Counties which hitherto has been its known limits of distribution. This is the first report of the species from Oregon.

BASIDIOMYCETES

1. Family UREDINACEAE

35. *Puccinia Burnettii* Griff.

On *Sidalcea*, Linn County, east of Corvallis. July. No. 224[illegible].

36. *Puccinia gigantispora* Bubak.

On *Anemone*, Mary's Peak. August. No. 2265.

37. *Puccinia Lapsanae* Fuckel.

On *Lapsona communis*, Corvallis. August. No. 2245.

38. *Polythelis thalictri* (Cher.) Arthur.
On *Thalictrum occidentale,* Corvallis. August. No. 2246.

2. Family USTILAGINACEAE

39. *Schizonella melanogrammia* (DC.) Schroet.
On *Carex,* Linn County, east of Corvallis. August. No. 2247.

3. Family TREMELLACEAE

40. *Gyrocephalus rufus* Bref.
On humus in coniferous woods, Corvallis. October. Common. No. 2038.

41. *Tremella frondosa* Fries.
On oak stump, Corvallis. Infrequent. October to November. Nos. 2051, 2190.

42. *Tremella lutescens* Pers.
On stumps and fallen dead wood, Corvallis. Frequent. October to November.

43. *Tremella mesenterica* Retz.
On oak stump, Corvallis. Infrequent. May. No. 1958.

44. *Naematelia encephala* (Willd.) Fries.
On *Pseudotsuga* and *Abies,* Corvallis. February. Frequent. Nos. 1894, 1901. This western variety is much larger than typical *N. encephala* and the core is pure white.

45. *Exidia recisa* Fries.
On dead bark of apple and other deciduous trees, Corvallis. November. Infrequent. No. 1968. This species has a translucent wine color and shades of brown.

46. *Exidia Zelleri* Lloyd.[1]
On *Sambucus glaucus,* Corvallis. October. Infrequent. No. 1775. "Plants applanate to gyrose, about 1 mm. thick, surface even; color when fresh pale purplish-gray, subtranslucent with faint violaceous cast, drying darker. Papillae very few, scattered, globose. Basidia globose, hyaline, 12–14 μ, imbedded in a thin layer, close to surface. Spores 6 x 20 μ, hyaline, curved or rarely straight."—Lloyd. This plant is very close to *Tremella violacea,* according to Lloyd, but differs in size, size and shape of spores, and in the fact that the basidia are embedded in a very thin layer.

47. *Dacryomyces aurantia* Schw.
On fir stumps, Corvallis. May. Infrequent. No. 1957.

2. Family CLAVARIACEAE

48. *Sparassis radicata* Weir.
Parasitic on roots of Douglas fir, Philomath. November. Rather frequent. No. 2163.

49. *Clavaria pistillaris* Fries.
On the ground in mixed woods, Mary's Peak, Tidewater and Corvallis. December to June. Frequent. Nos. 1726, 1967.

[1] Lloyd, C. G. Mycological Notes 62: 931. 1920.

50. *Clavaria corniculata* Fries.

On ground under *Pseudotsuga taxifolia,* near Corvallis. December. Frequent. No. 1972.

51. *Clavaria mucida* Pers.

On rotten oak log, Corvallis. December. Infrequent. No. 1971.

52. *Clavaria cristata* Fries.

On the ground in mixed woods. This is the most common white *Clavaria* in the woods about Corvallis. It appears after the rains start in the fall and can be found until the early spring. No. 1877.

53. *Clavaria abietina* Fries.

In fir woods on Mary's Peak trail. October. No. 1731.

This plant has a thickened base, the branches wrinkle longitudinally when dry. The flesh is white but turns greenish when bruised. It has a bitter taste. Common in fir woods in western Oregon.

54. *Clavaria botrytis* Fries.

In coniferous woods, Blue River. November. Nos. 2152, 2157.

55. *Clavaria vermicularis* Fries.

In mixed woods, Corvallis. October. Infrequent. No. 2037.

56. *Calocera cornea* Weinm.

On dead fir wood, Corvallis. September to October. Frequent. No. 2062.

57. *Typhula phacorrhiza* Fries.

On fallen alder leaves, Philomath-Alsea road on Alsea Mountain, about a month after the fall rains begin. Frequent.

The hair-like clubs usually stand about 7–12 cm. tall from small disk-shaped, brownish sclerotia, 7–11 mm. in diameter by 1.5–3 mm. thick. This form is common in thick stands of alder in western Oregon and Washington.

3. Family THELEPHORACEAE

58. *Craterellus cornucopioides* (L.) Pers.

On ground among *Gaultheria shallon* in a clearing of coniferous woods, near Mary's Peak, Benton County. December. Infrequent. No. 2167. Collected by C. C. Epling.

This plant was not reported west of Missouri in Burt's monograph. It is plentiful when found, and is larger than usual, reaching 12 cm. high and 7 cm. broad.

59. *Stereum fuscum* (Schrader) Quél.

On alder, Corvallis. May. Infrequent. No. 1948.

60. *Stereum purpureum* Pers.

On pear trunk, Corvallis. December. Infrequent. No. 2214.

No "silver leaf" has been observed in connection with infections of this fungus.

61. *Thelephora palmata* (Scop.) Fries.

On the ground in pathways in mixed woods. In the hills northwest of Corvallis and on Mary's Peak. March. Infrequent. No. 2091.

62. *Corticium lactescens* Berk.

On oak, Baldy Peak and Corvallis. March and September. Frequent. Nos. 1771, 1905.

63. *Coniophora cerebella* Pers.

This very active wood-destroying organism was found near Philomath, on the charred bark of *Thuja plicata, Pseudotsuga taxifolia* and *Tsuga heterophylla.* Although known from Washington and California *Coniophora cerebella* has not been previously reported from Oregon. Nos. 1795, 1796, 1797.

64. *Cyphella marginata* McAlpine.[2]

On twigs of peach, apple and almond, Marion, Benton, and Douglas Counties. May to July. Frequent. Nos. 1830, 1831, 1922, 1940, 2102.

Previously this fungus has been reported from Australia only. There is no record of the importation of nursery stock which would carry this fungus from Australia into Oregon. The fungus is inconspicuous and is perhaps of little, if any, economic importance. In Australia McAlpine observed this fungus on dead twigs of peach but in Oregon it is abundant on "die-back" twigs of peach and apple and has been found in one locality on almond. The cupules are minute, resembling fuzzy, gray or ochraceous goblets. They are peziza-like in appearance, about 0.5–1 mm. in diameter.

65. *Peniophora glabra* (B. & C.) Burt.

On Douglas fir, Corvallis. September. Infrequent. No. 1860.

66. *Peniophora glebulosa* Bres.

On decayed wood in mixed woods, Corvallis. August. Infrequent. No. 1813.

67. *Peniophora incarnata* (Fries) Cooke.

On oak, Corvallis. March. Infrequent. No. 1906.

68. *Peniophora cinerea* Fries.

On alder, Philomath-Alsea road on Alsea Mountain. November. Infrequent. No. 2230.

69. *Hymenochaete spreta* Peck.

On alder and Douglas fir, Corvallis. August and February. Infrequent. Nos. 1852, 1896.

70. *Aleurodiscus subcruentatus* (B. & C.) Burt.[3]

On *Pseudotsuga taxifolia* and *Abies grandis,* Corvallis. August and September. Frequent. Nos. 1722, 1809, 1951.

According to Dr. Burt this was "described from a collection made in Japan about 60 years ago by the U. S. Northern Pacific Exploring Expedition." Since the publication of his monograph of the genus *Aleurodiscus* he has "received Oregon collections and collections from Japan and California. This is not recorded as turning up before since the original collection."

71. *Aleurodiscus amorphus* (Pers.) Robh.

On fir bark, Corvallis. November. Frequent. No. 1791.

[2] McAlpine, D. Fungous diseases of stone-fruit trees in Australia 120–122. 1902.

[3] Burt, E. A. Thelephoraceae of North America. XII. Stereum. Ann. Mo. Bot. Gard. 7: 237. 1920.

4. Family HYDNACEAE

72. *Hydnum ochraceum* Pers.

On Douglas fir stump, Corvallis. August. Frequent. No. 1806.

73. *Hydnum erinaceus* Bull.

On Douglas fir log, Philomath. October. Frequent. No. 2135.

74. *Hydnum auriscalpium* Linn.

On cones and needles of *Pseudotsuga taxifolia,* Corvallis. November to January. Frequent. Nos. 2138, 2221.

75. *Hydnum repandum* Linn.

In open woods, various localities in western Oregon. November. Frequent. Nos. 2136, 2193.

The western plants are a deeper orange than the pale buff plants I have collected in the middle west.

76. *Hydnum subfuscum* Peck.

On coniferous bark, Mary's Peak trail. October. Frequent. No. 1724.

77. *Echinodontium tinctorum* Ellis.

A resupinate specimen found on *Abies grandis,* Corvallis. April. Frequent. No. 1912.

78. *Irpex lacteus* Fries.

On cherry stumps or causing heart rot of living trees from large pruning cuts. Fall and spring. Frequent. No. 1824. This is the most common heart rot of sweet cherry in western Oregon.

79. *Odontia fragilis* Karst.

On oak, Corvallis. August. Infrequent. No. 1848.

80. *Radulum Owensii* Lloyd.

On oak, Corvallis. March and April. Frequent. Nos. 1907, 1932.

5. Family BOLETACEAE

81. *Boletus chrysenteron* With.

In mixed woods, Corvallis. Comes with the early fall rains and persists until November. Common.

82. *Boletus luridus* Schaeff.

Under conifers, Oregon Agricultural College campus, Corvallis. September. Infrequent. No. 2058.

Although this plant has been reported from Washington and California, it had not previously been reported from Oregon.

83. *Boletus luteus* Fries.

Under conifers, Oregon Agricultural College campus, Corvallis. November. Common. No. 2035. This is a very common plant from early fall until the first freeze. It is always to be found under conifers in season.

84. *Boletus scaber* Fries.

Under various trees, Oregon Agricultural College campus, Corvallis. September. Infrequent. No. 2059.

If this were to be referred to one of Peck's varieties it perhaps would come nearest to *fuligineus.* Variety *testaceus* has also been observed in this locality.

85. *Boletus Zelleri* Murrill.

In coniferous woods, Corvallis. October to November. Frequent.

86. *Boletinus cavipes* Opat.

Under birch trees, Oregon Agricultural College campus, Corvallis. October. Infrequent. No. 2052.

This plant has not previously been reported west of the Rocky Mts.

6. Family POLYPORACEAE

87. *Cryptoporus volvatus* (Peck) Shear.

On *Tsuga, Pseudotsuga* and *Abies* in the Coast Range Mountains. September to November and spring. Frequent.

88. *Fomes annosus* (Fries) Cooke.

On *Pseudotsuga taxifolia* (log), Philomath-Alsea road. November. Infrequent. Nos. 1759, 2140.

89. *Fomes applanatus* (Pers.) Wallroth.

On wood of various deciduous trees, usually saprophytic but undoubtedly parasitic on the collar and roots of Italian prune trees. Frequent. Fall and spring. No. 1959.

The form of this fungus having a white context (*Fomes leucophaeus* Mont.) is very commonly found in western Oregon. This form has been observed upon thoroughly water-soaked, decayed wood of *Populus* and *Acer*. Specimens which were brought into the laboratory to dry became the usual brown color which progressed upwards from the tubes as the fungus dried out. Perhaps this white color is associated with a thoroughly saturated condition which does not allow of the usual oxidation.

For two years the progress of root rot in prune trees caused by *F. applanatus* has been watched with interest. In November, 1919, an orchard of about 20 acres in Douglas County was visited and many trees had blown over in a recent wind storm. The trees had blown over while in full leaf and some in full fruit. An examination of the fallen trees to ascertain the cause of root weakness revealed a decayed condition of the roots. Many roots exhibited resupinate fruiting bodies of *F. applanatus* and all of the fallen trees (about 20) had the white butt-rot characteristic of *F. applanatus* decay. In the spring of 1921 the same orchard was visited and many more trees were observed with fruiting bodies on the lower portion of the trunk and on the roots. Such trees had very loose footing. Usually the infection could be traced from wounds near the base of the trunk or on shallow roots probably caused by cultivation machinery. The trees were in good soil and apparently otherwise in good vigor except that the upper trunk and larger branches showed heart rot due to *Trametes carnea*. In this case *Fomes applanatus* is at least a destructive *facultative* parasite.

90. *Fomes igniarius* (L.) Gillet.

On apple trees, Canyonville, Douglas County, and Corvallis. May and February. Infrequent. Nos. 1900, 1921.

91. *Fomes pinicola* (Swend.) Cooke.

On peach and prune trees, western Oregon. Frequent. Nos. 1786, 1815.

92. *Fomes roseus* (A. & S.) Cooke.

On *Abies grandis,* Corvallis. March. Rare. No. 1908.

I have seen but one specimen which I can refer to this species. This was definitely perennial, and ungulate with a black surface.

93. *Polyporus arcularius* (Batsch) Fries.

On oak wood, Corvallis. August. Infrequent. Nos. 1987, 1989. Not previously reported from the Pacific coast.

94. *Polyporus chioneus* Fries.

On oak and maple, Corvallis. October. Infrequent. Nos. 1753, 1974. One of these numbers was referred to *P. trabeus* Fries by Mr. Lloyd, but it surely differs but little from *P. chioneus.*

95. *Polyporus dryadeus* (Pers.) Fries.

On *Acer macrophyllum* and *Abies grandis,* Mary's Peak and Cascadia, respectively. September. Not infrequent. Nos. 1765, 2061. The dozen or more applanate fructifications on maple were on a dead stub but the one obtuse specimen on *Abies* was on a living tree. Although usually reported as found on living oak this species of late has been reported on a variety of hosts.

96. *Polyporus floriformis* Quél.

On decayed maple, Corvallis. October. Infrequent. No. 2019. Although this species usually has an attenuate or lateral stem-like base my specimens were sessile. To my knowledge this form has not been reported from west of Wisconsin.

97. *Polyporus fragilis* Fries.

On *Abies grandis,* Corvallis. October. Infrequent. No. 2016. This plant is white at first as usual in this species but when touched it changes to livid pink or flesh-colored when dried or brick-red when a bruised portion is dried. The spores are alantoid, 1–1.5 x 5 μ.

98. *Polyporus galactinus* Berk.

On prune, Riddle, Douglas County. November. Infrequent. No. 1792.

99. *Polyporus hirsutulus* Schw.

On sweet cherry, Corvallis. April and May. Frequent. Nos. 1933, 1934, 1937.

This form has not been reported from west of Missouri but it perhaps occurs wherever *P. versicolor* (L.) Fries is found, for it is probably a segregate of that species.

100. *Polyporus hirtus* Quél.

On ground, Powers. October. Infrequent. No. 2040.

101. *Polyporus Macounii* Lloyd.

On maple, Corvallis. October. Frequent. No. 2054. Perhaps another segregate of *P. versicolor.*

102. *Polyporus picipes* Fries var. *castaneus* Lloyd.

On maple log, Mary's Peak. October. Infrequent. No. 1742. This is a very clean, neat form of the species. It has a uniform tawny-olive color.

103. *Polyporus pubescens* (Schumacher) Fries.

On cherry, Corvallis. April. Frequent. No. 1834.

104. *Polyporus rufescens* Pers.

On oak stump, Corvallis. November. Infrequent. No. 1793.

105. *Polyporus sensibilis* Murrill.

On *Abies grandis*, Corvallis and Mary's Peak. October. Not infrequent. Nos. 1754, 2018.

This plant has been reported once from Oregon by Dr. Murrill, the collection taken at Glenbrook.

106. *Polyporus Spraguei* B. & C.

On dead *Quercus Garyana*, Corvallis. October No. 2114.

I have in my herbarium (No. 546) a collection of this species taken in Seattle, Washington. This is a considerable extension of range for the species from the Mississippi Valley.

107. *Polyporus zonatus* Fries.

On cherry and pear, Corvallis and Medford. Frequent. Nos. 1893, 1899.

P. zonatus has very little to distinguish it from *P. versicolor*, of which it is perhaps a segregate.

108. *Hexagonia carbonaria* B. & C.

On charred wood, Corvallis. February. Infrequent. No. 1887.

109. *Poria contigua* (Pers.) Karst.

On decayed wood of *Quercus Garyana, Corylus californicus* and sometimes *Acer macrophyllum*, western Oregon. Very frequent. Nos. 1723, 1808, 1888, 1891, 1920, 2220.

This is a most common brown *Poria* in western Oregon. It is sometimes found reflexed where moss fronds have been followed but infrequently it has been found reflexed without apparent provocation.

Dr. L. O. Overholts says concerning this fungus, "I have European material from Romell with which it agrees exactly. Romell has written me that he considers *P. contigua* identical with *Trametes tenuis* Karst., and I am inclined to the same opinion." The writer has reflexed specimens among those cited above and perhaps the plant should be listed under *Trametes*.

110. *Poria sanguinolenta* (A. & S.) Fries.

On oak fence post, Corvallis. March. Infrequent. No. 1902.

111. *Trametes carnea* (Nees) Cooke.

On peach, prune and conifers, western Oregon. Late fall, winter and spring. Extremely common. Nos. 1760, 1783, 1826, 1827, 1862, 1885, 1909, 1930, 2146.

Trametes carnea causes more than 90% of all the heart-rot of prune and peach trees in the orchards of western Oregon. It is extremely destructive, producing a rot which cannot be distinguished from that produced by this fungus in coniferous woods. I believe this fungus to be a true *Trametes*. It does not become perennial. I have watched the same stumps for several seasons and the fruiting bodies die each season and new ones appear in their stead the following season. There seems to be layered growth marked by horizontal lines in vertical cuts through the context but this evidently represents periodicity of growth during a season rather than perennial growth. I believe this is distinct from the perennial *Fomes roseus*.

112. *Trametes hetermorpha* Fries.

On *Pseudotsuga taxifolia,* Corvallis. March. Infrequent. No. 2092.

113. *Trametes hispida* Bagl.

On *Populus,* Freewater. May. Rare. No. 2017 (O. A. C. Herb. 2123).

This large fruiting body, 18 x 10 x 7 cm., is more or less of a monstrosity for this species. The tubes are extremely variable and large, reaching 25 mm. in length. The variation seems mainly to be one of size for in microscopic characters it is not very different from *T. hispida.*

114. *Merulius brassicaefolius* Schw.

In November, 1919, Mr. C. E. Waterman of Newberg sent me a specimen of this fungus which he collected from a sill of Douglas fir wood. The sills are about 20 inches from the ground and resting on oak blocks. The specimen of decayed wood sent with the fungus is a brown, dry rot which runs very rapidly during humid weather. The hyphae in the lumen of the tracheids are hyaline, 3–4 μ in diameter and septate with occasional clamp-connections. This collection extends the range of this fungus west from Louisiana. No. 1780.

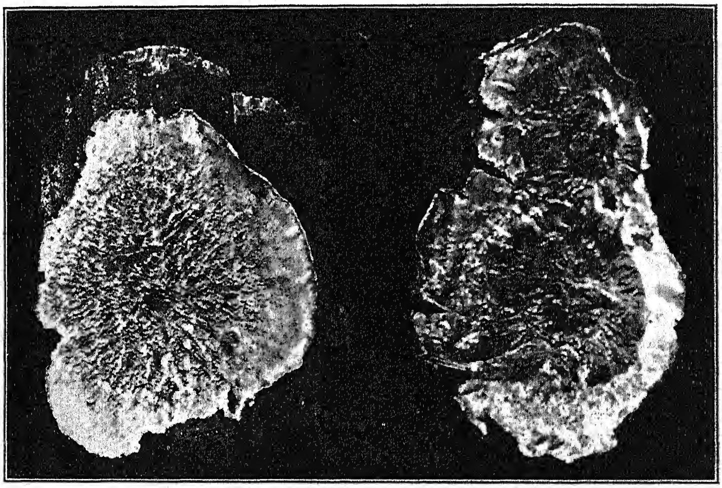


Fig. 1. Fructifications of *Merulius pilosus* Burt. Nat. size.

115. **Merulius pilosus** Burt, sp. nov.

Fructification resupinate, orbicular, fleshy, separable, drying capucine-buff, the margin entire, rather thick; hymenium at first with somewhat radial folds which become venosely connected and form shallow, angular, irregular pores about 1 to 2 to a mm.; in structure about 1–1¼ mm. thick, composed of densely arranged, hyaline hyphae, 3–4 μ in diameter, not incrusted; clavate gloeocystidia up to 60 x 10–12 μ are abundant in the subhymenial region; cylindric hair-like cystidia, 3–4 μ in diameter, emerge up to 40 μ in the hymenium; spores hyaline, even, 3 x 2 μ. Fructification 6–7 cm. in diameter.

On very rotten, decorticated, frondose wood, Corvallis, Oregon, September 28, coll. *S. M. Zeller 1772*, type (in Mo. Bot. Gard. Herb. 56849).

M. pilosus is distinguished by its capucine-buff color, fleshy structure, presence of gloeocystidia and cystidia, and the minute spores; gloeocystidia have not been found in any other North American species with the exception of *M. rugulosus* of the West Indies.

All of the above notes and diagnosis of *M. pilosus* was kindly sent to the writer by Dr. E. A. Burt. The accompanying photograph (Fig. 1) of the type was taken when the collection was made.

116. *Merulius tremulosus* Schrader.

Although Dr. Burt did not examine any specimens of this species from Oregon, it is very common on decaying, hard woods during the fall months.

6. Family AGARICACEAE

117. *Amanita muscaria* Fries.

In the sandy tide flats along Willamette River, Corvallis. September. Frequent. No. 2153.

This poisonous *Amanita* is very common in the early fall on the sandy bottom land along the Willamette river. The plants are very large and striking in color, the disk usually English red and the margin orange-chrome. A specimen reaching 28 cm. high and with a pileus 21 cm. broad weighed 3 lbs., 6 ozs.

118. *Amanita calyptrata* Peck.

In coniferous woods, Mary's Peak and Corvallis. October. Frequent. Nos. 1766, 2126.

119. *Amanita pantherinoides* Murrill.

In coniferous woods and open oak thickets, Corvallis. November. Frequent. No. 2150.

120. *Amanita solitaria* Fries.

Solitary on ground in oak woods, Corvallis. October and November. Rare. No. 2063.

This plant has not previously been reported from Oregon although it is known to grow on the Pacific slope in California. According to Dr. Gilkey it has been collected in past years in several counties in this vicinity. Our plants have practically no odor nor taste unless slightly farinaceous.

121. *Amanita chlorinosma* Peck.

Solitary on ground in scrubby oak thicket, Corvallis. October and November. Rare. Collected by Mr. Carl C. Epling (333).

This species is strikingly like *A. solitaria* in morphological characters differing, however, in size of spores and in odor. *A. chlorinosma* has a strong, marked odor. In the specimen cited above the odor was designated as "of potash or of strong alkaline urine."

122. *Amanitopsis vaginata* Fries.

In coniferous woods mostly, Mary's Peak. October. Common. No. 1778.

The common variety of this species to be found in western Oregon

is *livida*. The white form, *alba*, is rarely to be seen. The grayish-mouse-colored variety attains a very large size in the mountains of the coast range. My collection has the pileus hair-brown in color, 10–18 cm. broad, and the plants reach 28 cm. high. Scales on the stipe are mouse-gray.

123. *Lepiota clypeolaria* Fries.

In mixed or coniferous woods, Corvallis. November. Commonly found west of the Cascade Mountains. No. 2183.

124. *Lepiota granulosa* Fries.

In mixed woods, Corvallis. October. No. 2033. This species is common throughout western Oregon.

125. **Lepiota pulcherrima** sp. nov.

Pileus 6–12 cm. broad, subhemispheric at first, then convex to quite plane, moderately fleshy, young buttons quite solid, acajon-red to Vandyke red at the center, venetian- or alizarine-pink on the margin, often fading to a silvery livid-pink in age; cuticle on margins of older specimens split; surface appearing velvety because of the innate-pubescence towards the center, nearly glabrous or silky on the margin or squamulose when closely covered by another pileus, becoming slightly appressed-scaly in age due to growth. Margin sterile. Flesh white, rather thin except disk. Gills free, white, close, broad, rounded behind, edges even. Stem 5–10 cm. long, 8–12 mm. thick, equal or tapering upward, slightly bulbose, peronate by a thin membrane colored like this pileus about one half to two thirds of the way up to the rather large, flaring, rather fleshy, persistent annulus, white within, white to pinkish above the annulus. Spores smooth, white, oblong, $3–4.5 \times 5–8$ μ, usually uniguttulate. Pleasant flavor. Odor mildly farinaceous.

Gregarious to caespitose. Growing from a distinct, heavy spawn in needle mould under *Pseudotsuga taxifolia*. (November to December.)

This is the most beautiful species of *Lepiota* with concolorous pileus and booted stem which the writer has ever seen. It is distinctly characterized by the rich color and surface of the pileus and the color and peronate character of the stem. It has been found at two stations in this locality and in one of these evidently growing from the same spawn for two seasons in succession.

Specimens examined: Oregon, Corvallis, *J. W. Severy* and *S. M. Zeller* 2123, type (in Zeller Herb. 2123, N. Y. Bot. Gard. Herb. and O. A. C. Herb. 3390); *S. M. Zeller* 2171, 2172 and *C. C. Epling* 72 (all in Zeller Herb.).

126. *Lepiota rubrotinctoides* Murrill.

In coniferous woods, Corvallis. This species is very common from October to December and lasts for about four weeks after the rains begin. This often would be mistaken for *L. rubrotincta* Pk. by eastern collectors but it differs in the darker almost black disk and the spores average considerably smaller. The stipe often has rosy tints especially below the annulus.

127. *Armillaria albolanaripes* Atkinson.

On ground in coniferous woods, Corvallis. October and November. Common. No. 2131. This species has been reported from Oregon and California, but the writer has collected it as far north as Seattle, Washington.

128. *Armillaria corticata* (Fries) Pat.

On maple, Corvallis. November. Nos. 2053, 2154. This species has the appearance of a *Pleurotus* except for the presence of a veil which leaves an evanescent annulus or remnants on the margin of the pileus. This is the first report of the species from Oregon.

129. *Tricholoma bicolor* Murrill.

In mixed woods, Corvallis. October to December. Frequent. Nos. 2137, 2124.

This beautiful buff *Tricholoma* has commonly been found in either deciduous or coniferous woods in and about Seattle, Washington, and near Corvallis, Oregon. It is not among the first Agarics to appear after the rains start in the fall, but comes on in about three weeks and may be found until the first freezing weather. This species usually appears to some extent again in the spring but not so abundantly as in the fall. The dry, pruinose, buff cap and the extremely bitter taste are the characters which distinguish this from other Pacific coast species of the genus.

130. *Tricholoma personatum* Fries.

In mixed or coniferous woods, September to December. Common.

This species is one of the most widely distributed of the Agarics in western Oregon. It is mentioned here because of the enormous size attained, pilei over 18 cm. broad having been measured. It has been collected as late in the winter as January 4. At McMinnville several perfect "fairy rings" were observed on December 2. One of these measured 15 feet in diameter.

131. **Tricholoma subannulata** (Peck) comb. nov.

In lawns under deciduous trees, Corvallis. October to November. Infrequent. Nos. 2195, 2222.

Unfortunately Peck described this species from dried specimens and included it in *Armillaria*.[4] In *North American Flora* (10: 30, 1914), Murrill recombined the species as *Melanoleuca subannulata* (Peck) Murr. Since the species was described from dried specimens some of the distinguishing characteristics were overlooked. The plants are cinnamon to Mars-brown when fresh and although viscid in damp weather the surface is often somewhat scabrous. The gills are white with pinkish tints becoming tan when bruised, and they distil moisture during humid weather. They are not broad, anastomose or fork in the middle or behind; broader and rounded behind, marked by distinct transverse ridges or striations which persist in the dried specimens. The stipe is usually short, stout, 4–10 cm. long and 1.5–5.5 cm. thick. The odor is strongly but pleasantly farinaceous.

132. *Clitocybe odora* Fries.

In open wood lots, usually in mixed woods, Corvallis and Philomath. October to November. Nos. 2116, 2176.

This species which has not been reported west of Michigan is a rather common species in the Willamette Valley. The pileus is usually 5–8 cm. broad but plants have been found 10 cm. broad.

[4] Peck, Bull. Tor. Bot. Club **36**: 330. 1909.

133. *Pleurotus sapidus* Schulzer.

On maple, Corvallis. November. Rare. No. 2147.

The spores in ours are 8–11 x 3–4 μ, becoming a very distinct pale lilac in mass. The pileus is tan to ochraceous-yellow or gray. In *North American Flora,* the range of distribution is given as far west as the Rocky Mountains.

134. *Pleurotus serotinus* Fries.

On apple wood, Corvallis. December. No. 2069. This species has been observed on various hard woods very late in the fall, but it seems to be very frequent on winter-injured apple wood.

135. *Hygrophorus eburneus* Fries.

In oak thickets and woods, Corvallis. September to November. No. 2044. This is one of our most common early mushrooms.

136. *Hygrophorus miniatus* Fries.

In dense Douglas fir woods, on moss, about four miles west of Alsea. August. Observed but once and under conditions such that no collections were made. The plants were a deep vermillion with a white foot of the stem as in var. *sphagnophilus* Pk. but were growing in heavy mats of *Hylocomium triquetrum* instead of a Sphagnum bog.

137. *Lactarius pyrogalus* Fries.

In coniferous woods, Powers. October. No. 2041, collected by F. E. Price. One lone specimen of this poisonous species was sent in for identification. It is quite typical of those reported farther east.

138. *Russula ochrophylla* Peck.

One plant of this species was collected near Corvallis and brought in to our Mushroom Show in November. It was exceptionally large, measuring 14 cm., but agreeing in all other characters with the usual descriptions. Several specimens were observed in an oak grove at McMinnville in December.

139. *Cantherellus aurantiacus* Fries.

A typical specimen of this species was sent in from Elgin.

140. *Cantherellus floccosus* Schw.

In damp, thick coniferous woods, Corvallis and Mary's Peak. October to November. Not infrequent.

141. *Cantherellus infundibuliformis* Fries.

On damp soil in coniferous woods. Philomath. November. No. 2156. Although this fungus has never been reported from the Pacific states it is not a rare plant in western Oregon and Washington.

142. *Marasmius plicatulus* Peck.

Under pine on Oregon Agricultural College campus. December. No. 2173. This is a beautiful velvety species.

143. *Trogia crispa* Fries.

On prune bark, Corvallis. March. No. 2088. This is the first report of this species west of the Rockies. Collection was made by C. E. Owens.

144. *Lenzites saepiaria* Fries.

This species is mentioned here because of its occurrence as a wound parasite on peach and prune. It becomes quite a serious pest on peach trees when the orchards are adjoining coniferous woods. Nos. 1779, 1784, 1785, 1931.

145. *Lenzites vialis* Peck.

On pruning wounds of apple trees, Roseburg, Douglas County. May. Infrequent. No. 1994.

146. *Pholiota spectabilis* Fries.

At the base of Douglas fir stumps, Corvallis. October to December. Frequent. No. 2122.

This plant grows to extremely large sizes in Oregon. The writer has collected specimens with pilei 8 in. broad and Professor Lake reports one over 12 in. broad, his photograph of which I could not resist publishing herewith (Fig. 2).

Fig. 2. Plant of *Pholiota spectabilis* having a pileus over 12 inches in diameter. Photo by Professor E. R. Lake.

147. *Inocybe fastigiata* Bres.

In mixed woods, Corvallis. October and November. Frequent. No. 2201.

148. *Naucoria semiorbicularis* Fries.

In lawns, Corvallis. October. Frequent. No. 2042.

149. *Agaricus diminutiva* Fries.

In mixed woods, Corvallis. October. Rare. No. 2029.

150. *Agaricus subrufescens* Peck.

In mixed woods, Corvallis. October. Rare. No. 2155.

This plant is mentioned here because to my knowledge it has not been previously reported from Oregon and because of its enormous size. The pileus of the plant collected measures 26 cm. broad and the stipe 24 cm. long with a diameter of 3.5 cm. above and 5.5 cm. below.

151. *Stropharia aeruginosa* Fries.

Under oaks on hills near Corvallis, November. Rather frequent. No. 2133.

152. *Stropharia ambigua* (Pk.) Zeller.

This is one of the most conspicuous of the Agarics to be found in coniferous and mixed woods of western Oregon during October and November. Nos. 1875, 2127.

153. **Stropharia rugomarginata** Zeller & Epling, sp. nov.

Pileus 6–12 cm. broad, fleshy, convex or broadly conic, becoming expanded to plane, glabrous, disk even; margin *reticulate-rugose* (pitted), pinkish-buff or cinnamon on the disk, drying cinnamon-buff to tawny-olive; flesh thin, whitish; lamellae crowded, thin, watery, broadly-adnate or slightly decurrent, edge undulate, minutely-serrate, concolorous becoming cinnamon, then tawny-olive in age, drying cinnamon-brown; spores ovoid-ellipsoid, appearing truncate at the apex because of a distinct germ-pore through the heavy exospore, usually obliquely-apiculate at the broader end, 8–9.5 x 4.5 μ, cinnamon-brown in mass when moist, mummy-brown when wet and Saccardo's umber when dry; basidia clavate-cylindric, 8.5 x 30–35 μ; stipe fleshy, solid or stuffed, glabrous, concolorous or whitish and shining above, subequal, tapering slightly either way, 6–12 cm. long, 12–15 mm. in diameter; annulus ample, persistent but sometimes disappearing at maturity, whitish. Odor and taste mild and not distinctive. In lawns under conifers. Solitary or subgregarious. December.

Stropharia rugomarginata is distinguished by the characters of the pileus and spores. The reticulate ridges on the pileus cause a pitting of a band of the surface near the margin about 1–2 cm. broad. The disk is even. In the younger plants the reticulate-rugose character disappears with drying but in the older plants it is retained as a faint, smooth, reticulation. The spores are distinctive in shape and color. The egg-shaped spore has a distinct germ-pore at the apex causing a truncate appearance and is usually attached obliquely at the broad end. When the spores were placed in enzyme solutions they threw out the germ tubes through the germ pores. When first shed in mass they appear more or less ochraceous but as they dry they become purplish-brown.

Specimens examined: Oregon, Corvallis, *S. M. Zeller* 2180, type (in Zeller Herb.) and *C. C. Epling* 314 (in Epling Herb.).

154. *Hypholoma fasiculare* Fries.

On dead wood, both coniferous and deciduous, Corvallis. October until frost. Nos. 1869, 2185.

This is undoubtedly the most common *Hypholoma* in the northwest. It is usually reported as saprophytic on coniferous wood but it is often found on deciduous trees and shrubs. It grows from the dead portions of the crowns of cane fruits (*Rubus*) but it has not been determined whether this infection was originally parasitic or merely following death of portions of the host due to other causes. In the Medford district, Jackson County, fruiting bodies were found at the base of apple trees

dying from root troubles, the cause of which is unknown to the writer who would hesitate to lay the cause definitely to this fungus. The symptoms of the diseased condition in these trees began by a slight yellowing of the foliage and reddening of the bark. The last year before the fruiting bodies of *Hypholoma fasiculare* appeared at the crown of the trees they bore a bumper crop but when tested they could be easily pushed over, for the roots were almost entirely decayed next to the crown. McAlpine[5] has reported *Hypholoma fasiculare* to be *parasitic* on the roots

129. 1902.

of raspberry and cherry in Victoria.

155. *Hypholoma capnoides* Fries.

On fence posts of *Abies* wood. Not commonly found; but abundant where found, Corvallis. November. Nos. 1868, 2204.

156. *Hypholoma hydrophilum* Fries.

Caespitose in large clusters on moss-covered, decayed logs, Philomath. November. No. 2197.

Our plant is not *H. hydrophilum* Fries (sense of Saccardo). These spores are 5–6 x 2.5–3 μ and there are no cystidia. The gills distil considerable moisture during damp weather.

157. *Hypholoma lachrymabundum* (Fries) Quél.

In coniferous woods, Corvallis. November. Rare. Epling No. 73.

This collection follows the description of *H. lachrymabundum* given by Kauffman[6] with the exception that it may be slightly darker. The spores are smooth, elliptical, *not curved* but flattish on one side.

158. *Hypholoma velutinum* (Fries) Quél.

On low ground under maples, Corvallis. October. Rare. No. 2055.

This collection agrees very well with my collection (506) of the same species taken in Tower Grove Park, St. Louis, Missouri. The spores are ovoid to *subcitriform with a hyaline apiculum, tuberculate,* dark purplish-umber when mature, 10 x 6–7 μ. The edges of the gills distil droplets darkened by suspended spores.

159. *Gomphidius oregonensis* Peck.

In damp coniferous or mixed woods, Corvallis. November. No. 2194.

This is one of the very common Agarics which comes shortly after the rains begin in the fall and may be found quite generally distributed in the wooded portions of western Oregon and Washington and is abundant. This was reported by Professor Lake as being a very palatable mushroom.

7. Family Lycoperdaceae

160. *Geaster delicatus* Morgan.

In humus soil under coniferous trees, Corvallis. October. Rare. No. 2047. This small species is mentioned here because it has not been reported from Oregon.

[5] McAlpine, D. Fungous diseases of stone-fruit trees in Australia, 125, 129, 1902.

[6] Kauffman, C. H. Agaricaceae of Michigan, 259.

161. *Geaster hygrometricus* Pers.

In oak thickets and coniferous woods, Corvallis and Portland. October and November. Not common. Nos. 1975, 2115. This is the large variety which Lloyd [7] has designated as *gigantea*. Our largest specimen measures 11.5 cm. when expanded.

162. *Geaster lagenaeformis* Vitt.

On ground under oaks on hills to northwest of Corvallis. October. No. 2049. This plant is very characteristically flask-shaped in the button stages. It is not commonly found in western Oregon.

163. *Geaster Morganii* Lloyd.

In oak woods, near Corvallis. October to November. Rare. No. 2048.

This collection of *G. Morganii* is perhaps the first reported from the Pacific coast. This collection contains four opened "stars" and one button. The plants do not differ from the eastern plants and are easily distinguished from other local species by their reddish-brown color and the cone-shaped, sulcate mouth of the endoperidium.

164. *Geaster saccatus* Fries.

On ground under *Acer macrophyllum*, near Corvallis. October. Rare. No. 2046.

This plant agrees with the description as given by Fries and is the same as that distributed by Ellis and Everhart (Fung. Col. Exs. No. 1217) but as far as the writer can learn it has not been reported from the west before.

165. *Lycoperdon cruciatum* Rostk.

On the ground, campus of Oregon Agricultural College, Corvallis. September. Not infrequent. No. 2022.

166. *Lycoperdon elegans* Morgan.

On ground under mixed trees, Corvallis. September. Infrequent. No. 1883.

167. *Lycoperdon fuscum* Bonar.

On ground in dense coniferous woods near Corvallis. November to December. Frequent. No. 1880. This apparently grows year after year from the same spawn which can be turned up at any season of the year.

168. *Lycoperdon gemmatum* Batsch.

Pastures and open woods, Corvallis. October to December. Frequent. No. 1881.

169. *Lycoperdon pyriforme* Schaeff.

On decayed wood of various species, Corvallis. November to December. Frequent. No. 1884.

170. *Lycoperdon pratense* Pers.

In lawns, Corvallis. August to October. Frequent. Nos. 1720, 1854.

171. *Lycoperdon pusillum* Batsch.

In lawns, Corvallis. August to October. Frequent. No. 2024.

172. *Lycoperdon rimulatum* Peck.

In lawns of Oregon Agricultural College campus, Corvallis. August to September. Frequent. No. 2025.

[7] Lloyd, C. G. The Geastrae. Bull. 2: 10. 1902.

173. *Lycoperdon Wrightii* Berk.

In spots where the grass is sparse, on Oregon Agricultural College campus, Corvallis. November. Infrequent. No. 2229.

174. *Bovista montana* Morgan.

On ground at the edges of coniferous woods, in lawns and cultivated gardens, Corvallis. May to September. Frequent. Nos. 1751, 1935, 2006.

175. *Bovista plumbea* Pers.

In cultivated gardens, Corvallis. August to September. Frequent. Nos. 2007, 2060.

176. *Catastoma circumscissum* (Berk.) Morgan.

In lawns, Oregon Agricultural College campus, Corvallis. August. Rare. No. 2208. Hard says this species "seems to be confined to the middle west."

177. *Calvatia gigantea* Batsch.

This species is found infrequently in pastures in various parts of western Oregon. A specimen from Multnomah County, collected in September, weighed 6 lbs. 7 oz. and measured 28 x 23 x 18 cm.

178. *Calvatia lilacina* Berk.

In open fields, lawns and cultivated gardens, Corvallis. August to November. Frequent. Nos. 1964, 2010, 2026.

Lloyd has called our western form var. *occidentalis.* It differs in being smaller and having less development of the sterile base.

179. *Calvatia rubro-flava* Cragin.

In mixed woods, north of Corvallis. September. Rare. No. 1995. I believe this is the first report of this species from the northwest.

8. Family SCLERODERMATACEAE

180. *Scleroderma cepa* (Vaill.) Pers.

Gregarious or caespitose, along sidewalks, High School ground, Corvallis. September and October. No. 2014.

The peridium in our plants is glabrous, sometimes cracked, warm buff or darker, sometimes buckthorn-brown, becoming light ochraceous-salmon to russet where bruised, reaching 12 cm. broad and 5 cm. high, about 1/3 emergent. Odor at first farinaceous, then disagreeable. Gleba a dark livid-brown just under the peridium and a warm blackish-brown or black near the center and base. Spores livid-brown to deep livid-brown under scope, spherical, sharply echinulate, 8–13 μ, according to maturity.

181. **Scleroderma hypogaeum** sp. nov.

Fructifications subglobose to irregular, firm but pithy when young, deliquescent with age, 1–7 cm. in diameter, color light buff to pale ochraceous-buff or even avellaneous, becoming bay to almost black when beginning to deliquesce. Surface glabrous or of innate-appressed fibrils. Mycelium of white rhizomorphs attached to the somewhat downward projecting sterile base. Peridium reaching 3 mm. thick, compact, hyaline; gleba at first white, then yellowish, turning purplish-umber at maturity (drying black where cut); tramal septa white, variable in thickness, of parallel, hyaline hyphae, gelatinizing and deliquescing at maturity; fertile cells at first filled with a hyaline, basidia-bearing capillitium, later filled with spores and remnants of capillitium; basidia hyaline, pyriform

to subglobose, 10–13 x 8–10 μ, usually 4-spored; sterigmata short, 3–4 μ long; spores subglobose, dark purplish-umber, alveolate-reticulate, 11–25 μ (average 14 μ). Odor pleasant farinaceous when young but becoming strongly alkaline when deliquescing. Taste farinaceous when young.

In clay soil under lawn sod. October to November and sometimes in spring.

S. hypogaeum is like *S. cepa* in that the peridium is glabrous but is entirely different from other species in the alveolate-reticulate character of the spores and its entirely hypogaeous habit. The spores are larger than reported for most species of *Scleroderma.* They average about 14 μ but in extreme cases they have been found to measure 30 μ when fresh. The measurements reported above are based on the dry specimens. The photograph (Fig. 3) presented herewith illustrates the hypogaeous habit of the fungus. It very rarely comes even with the surface of the soil.

Very early stages of this species have been killed and embedded for a histological study of the development of the sporophores. Specimens examined, Oregon: Corvallis. *S. M. Zeller* 1567, 1725, type (in Zeller Herb. and O. A. C. Herb. 3391); Philomath. *S. M. Zeller* 2139 (in Zeller Herb.).

Fig. 3. *Scleroderma hypogaeum,* showing the hypogaeous habit of the plant. Nat. size.

182. *Scleroderma aurantiacum* Bull.

In path in open field, Corvallis. November. Rare. No. 2211. Marked by the brassy-yellow peridium which is reticulate-rimose producing a more or less warty surface.

183. *Polysaccum turgidum* Fries.

In cultivated garden, Corvallis. September. Rare. No. 2050. Collected by Dr. Helen M. Gilkey, who says there have been as many as sixty fruiting bodies of this fungus in their garden during one autumn (Fig. 4).

The description of *P. turgidum* is the nearest to that of this collection that we could find available. The description of the Corvallis collection is given below for reference:

Fructifications clavate, 6–15 cm. broad above, 12–25 cm. long, firm; surface shiny amber to blackish-brown at maturity, areolate where the peridioles show through; peridium more or less gelatinous, up to 2 mm. thick below, very thin to deliquescent or entirely dehiscent above; gleba at first gelatinous then powdery, at first yellow-ochre, then purplish-black when still gelatinous, becoming mummy-brown when powdery; septa persistent, forming cavities containing the *peridioles* which are subspherical to gyrose, reaching 3 mm. broad and 7 mm. long, Natal-brown; stipe 6–8 cm. broad, 7–14 cm. long, surface more or less lacunose with large longitudinal cords or rhizomorphs, interior at first yellow-ochre then bister at maturity, solid. Spores 7.5–11 μ, spheric, echinulate with close, fine, sharp spines, brownish-purple under scope, Natal-brown in mass, 1–3 guttulate, exospore about 1–1.5 μ thick.

Fig. 4. *Polysaccum turgidum*, showing the general habit of a mature sporophore. ⅓ nat. size. Photo by Professor E. R. Lake.

184. *Arachnion album* Schw.

On lawns, Oregon Agricultural College campus, Corvallis. August. Infrequent. No. 1999.

9. Family HYMENOGASTRACEAE

185. *Rhizopogon diplophloeus* Zeller & Dodge.

In damp humus soil under *Quercus Garyana*, Corvallis. December. Rare. No. 2169.

186. *Rhizopogon induratus* Cooke.

In clay soil, Corvallis. December. Rare. No. 2168.

187. *Rhizopogon maculatus* Zeller & Dodge.

In humus or clay soil, under *Pseudotsuga taxifolia,* Corvallis. October to January. Rare. Nos. 2015, 2228.

This is the first report of this species outside of the type locality in California. It differs from the type in its thicker peridium (200 μ in places). The white outer layer of the duplex peridium is about 160 μ thick where the two layers total 200 μ. The outer layer varies in thickness while the inner layer is quite consistently 40 μ. The outer peridium is easily separable. The fibrils are almost white when fresh. The mycelium in the soil is in very fine fibrils hardly large enough to designate as rhizomorphs and gives to the soil a grayish-olive color. The fresh fructifications are almost odorless.

188. *Rhizopogon roseolus* (Corda) Zeller & Dodge.

In humus soil, under *Pseudotsuga taxifolia,* Corvallis. November. Not infrequent. Nos. 2132, 2141. The fructifications have a farinaceous odor when young but when ageing they possess an extremely foul odor.

189. *Rhizopogon rubescens* Tul.

In wood rat diggings in leaf mould, under conifers, McMinnville and Alsea. August and December. Not infrequent. Nos. 1962, 2170.

190. *Arcangeliella caudata* Zeller & Dodge.

On ground in leaf mould under *Quercus Garyana,* Corvallis. April. Rare. No. 2005. There are no apparent differences between this collection and the type collection from California.

191. *Gautieria morchelliformis* Vitt.

In humus under hazel, seven miles west of Alsea. August. Rare. No. 1969. This collection differs from those previously examined in that the columella is branched and reaches half way to the summit of the fructification. The odor when fresh is strongly foetid.

192. **Gautieria Parksiana** Zeller & Dodge, sp. nov.

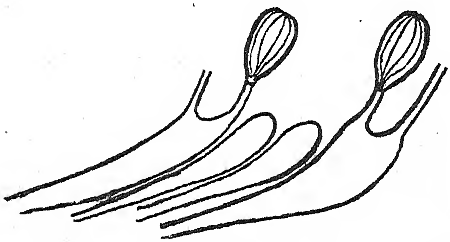
Fructifications gregarious, subglobose to irregular, 1–5 cm. in diam., some specimens drying light ochraceous-buff to ochraceous-tawny, others drying buckthorn-brown to mummy-brown; rhizomorphs white, 1–2 mm. in diam., usually branching from a distinct radicle; columella branched; peridium persistent, 240–420 μ thick, stupose, of very fine hyphae; gleba drying ochraceous-tawny to Dresden-brown; cavities 3–4 per mm., empty, globose to irregular; septa 65–100 μ thick, hyaline, of interwoven hyphae generally extending longitudinally; basidia clavate, arising from the trama obliquely, usually 2-spored, 28–38 x 7–10 μ hyaline (Fig. 5); sterigmata 5–14 μ long; spores ovate to citriform, buckthorn-brown in mass, pale-olivaceous under microscope, with 9–11 (usually 10) rounded, longitudinal ribs giving the appearance of striations, 7–11 x 14–19 μ, nucleus equitorially placed (Figs. 5, 6).

In soil under *Heteromeles* and *Pseudotsuga.* Oregon to California. March to June.

In a previous publication[8] we tentatively included *Chamonixia* Rolland in the genus *Gautieria* because in the early stages of the latter a peridium is evident. At that time we had not had the opportunity to collect and

[8] Zeller, S. M., & Dodge, C. W. *Gautieria* in North America. Ann. Mo. Bot. Gard. 5: 133–142. 1918.

examine fresh specimens of species having a more or less persistent, thick peridium nor those having a thin peridium evanescent at an early stage of development. Since then the observations of one of us and the valuable data, which H. E. Parks of the University of California is continuously procuring, have proven to us yet more conclusively that *Chamonixia* should be reduced to synonymy or at least subgeneric rank. We have in *Gautieria Parksiana* possibly as true a *Chamonixia*-type as presented in *Chamonixia caespitosa* Rolland. The peridium is thick and persistent. Parks says that in plants (his collection Nos. 356, 812) which had dried in the soil during June the peridium still persisted although ruptured in many places. The Oregon collection cited below was taken in June and these plants exhibit a thick peridium. Parks' collections in June were taken from the same area of ten square feet of soil where the type collection of 47 fructifications had been collected during the previous March. We take great pleasure in dedicating this species to Mr. Parks.



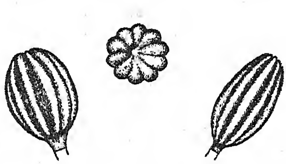


Fig. 5. Basidia and paraphyses of *Gautieria Parksiana*. × 600.
Fig. 6. Spores of *Gautieria Parksiana*. × 900.

Gautieria Parksiana is distinct from *Chamonixia caespitosa* in several characters. The bruised outer surface and cut surfaces of the peridium do not turn blue; the distinct, radicate rhizomorph leads to a branched columella which is not so distinct nor does it divide the fructification into such distinct portions as described for the columella of *Chamonixia caespitosa*. The spores of *G. Parksiana* are not guttulate and average smaller than those of *C. caespitosa*. We will defer recombining *C. caespitosa* until authentic material of this species is examined.

Specimens examined, Oregon: Benton County, Corvallis. *S. M. Zeller* (in Zeller Herb. 1970 and O. A. C. Herb. 3392). California: Saratoga. *H. E. Parks* 441, type (in Parks Herb. 441, in Zeller Herb. 1678, and in Dodge Herb. 1496); Guadaloupe Mines. *H. E. Parks* (in Parks Herb. 415 and Zeller Herb. 1692).

193. *Gymnomyces pallidus* Massee & Rodway.

Fructification irregular, 3–4 cm. in diameter, light-buff when fresh drying ochraceous-buff to yellow-ochre; peridium, stipe, and columella lacking; gleba light-buff when fresh, drying light ochraceous-buff; no sterile base; cavities 1–2 mm. broad when fresh, 3–4 to the mm. when dry, irregular; septa hyaline, about 80 μ broad, not scissile; basidia

hyaline, clavate, 2-spored; 8–9 x 25–30 μ; sterigmata 3–5 μ long; spores subglobose, hyaline, 8–11 μ, verrucose, uniguttulate, often short-caudate; odor fragrant.

In clay soil under leaves of *Quercus Garyana*, Corvallis, Oregon. December. Rare. Collected by L. M. Boozer. No. 2208 (O. A. C. Herb. 3393).

The one fructification in the Corvallis collection is described above. It follows very closely the original description of *Gymnomyces pallidus* but the writer has not examined authentic specimens of this species. This plant has nearest affinities with *G. Gardneri* Zeller & Dodge through its spore characters, but is markedly different in that it has no columella. The fragrant odor is that so characteristic of many fleshy polypores. *Gymnomyces pallidus* has not been known outside of its type locality in Tasmania.

10. Family NIDULARIACEAE

194. *Cyathus stercoreus* Schw.

On soil, Mary's Peak, Benton County. October. Common. No. 1996.

195. *Cyathus vernicosus* Bull.

In cultivated soil, Corvallis. November. Common. No. 1977.

196. *Crucibulum vulgare* Tul.

On organic matter, Corvallis. October. Common. No. 2057.

197. *Sphaerobolus stellatus* Tode.

On decayed wood, Corvallis. November. Infrequent. No. 1799.

FUNGI IMPERFECTI

1. Family MELANCONIACEAE

198. *Cylindrosporium acerinum* Tracey and Earle.

On leaves of *Acer circinnatum*, Mary's Peak, Benton County. July. Frequent. No. 1943.

2. Family MONILIACEAE

199. *Sepedonium chrysospermum* (Bull.) Fries.

On *Boletus luteus*, Corvallis. September to November. Frequent. Determined by C. C. Epling. No. 2177.

200. *Mycogone pucciniodes* (Preuss) Sacc.

On *Boletus* sp., Corvallis. September. Rare. Determined by C. C. Epling. No. 1369.

201. *Mycogone roseola* Pound and Clem.

On *Helvella crispa*, Corvallis. December. Rare. No. 2178.

202. *Ramularia Oxalidis* Farlow.

On leaves of *Oxalis oregana*, Mary's Peak, Benton County. July. Frequent. No. 1944.

3. Family DEMATIACEAE

203. *Cercospora fusimaculans* Atkinson.

On *Panicum* sp., Mary's Peak Trail, Benton County. July. Infrequent. No. 1997.

To the writer's knowledge this species has been reported from the Gulf States only. This is an interesting extension of range.

4. Family TUBERCULARIACEAE

204. *Strumella coryneoidea* Sacc. & Wint.

On dead twigs of *Quercus Garyana,* on the lower part of Mary's Peak Trail, Benton County. October. Rare. No. 2009.

It was surprising to find this species ranging so far west since it is a native of the northeastern part of North America. Only a very small amount of the *sporodochial* material was found. I do not believe the disease is at all serious in Oregon for further extended search for it has been fruitless.

OREGON AGRICULTURAL COLLEGE,
CORVALLIS, OREGON.

DARK-SPORED AGARICS—III

Agaricus

William A. Murrill

In my last article *Gomphidius* and *Stropharia* were discussed. The genus *Agaricus,* as at present limited, differs from them both in having free lamellae.

Agaricus L. Sp. Pl. 1171. 1753

Pratella S. F. Gray, Nat. Arr. Brit. Pl. 1: 626. 1821.
Psalliota Quél. Champ. Jura Vosg. 107. 1872.

This genus, distinguished among brown-spored gill-fungi by a fleshy stipe, free lamellae, and the presence of an annulus, has received much attention because of the important edible species in it. The different species are usually not very well characterized, being much the same in shape and color and differing very little in spore characters. A number of new ones have been described from tropical America and from the Pacific coast. See Mycologia for March, 1918, and for November, 1912.

Pileus white or yellowish or becoming so; tinged with lilac in *A. variabilis* and sometimes with rose in *A. comtulus.*
  Pileus 2–5 cm. broad.
    Pileus white, becoming yellowish.
      Stipe 4 mm. thick. — 1. *A. comtulus.*
      Stipe 10 mm. thick. — 2. *A. alabamensis.*
    Pileus yellow, becoming nearly white. — 3. *A. comtuliformis.*
  Pileus larger, usually 5–15 cm. broad.
    Pileus white, unchanging.
      Surface squamose. — 4. *A. solidipes.*
      Surface deeply rimose-areolate. — 5. *A. praerimosus.*
      Surface smooth, glabrous or fibrillose.
        Pileus 7–12 cm. broad. — 6. *A. pilosporus.*
        Pileus usually 5–7 cm. broad.
          Annulus cup-like. — 7. *A. chlamydopus.*
          Annulus not cup-like. — 8. *A. campester.*
    Pileus white, becoming yellowish; or tinged with yellow at the center.
      Pileus lilac-tinted when young, yellowish when older. — 9. *A. variabilis.*
      Pileus yellowish at the center.
        Pileus 5–10 cm. broad. — 10. *A. Rodmani.*

Pileus 10–15 cm. broad. 11. *A. floridanus.*
Pileus becoming yellowish.
Spores 4–5 μ long. 12. *A. cretacellus.*
Spores 5–7 μ long.
Spores very broadly ellipsoid, about 7 x 5.5 μ. 13. *A. pratensis.*
Spores 5–7 x 3–4 μ. 14. *A. sylvicola.*
Pileus some shade of gray, brown, or reddish-brown, at least on the disk or with age.
Pileus glabrous or fibrillose; sometimes slightly squamulose in *A. brunnescens* and *A. micromegethus.*
Pileus about 2–5 cm. broad.
Stipe 1–2.5 cm. long; context not changing color when cut. 15. *A. micromegethus.*
Stipe 2.5–4 cm. long; context becoming blackish when cut. 16. *A. argenteus.*
Stipe 5–10 cm. long; context becoming reddish when cut. 17. *A. rutilescens.*
Pileus 5–20 cm. broad.
Stipe 2.5–5 cm. long.
Context whitish, unchanging. 18. *A. brunnescens.*
Context whitish, quickly reddening when cut. 19. *A. halophilus.*
Stipe 10–15 cm. long. 20. *A. magniceps.*
Pileus distinctly squamulose or echinate.
Pileus 1–4 cm. broad.
Pileus echinate. 21. *A. echinatus.*
Pileus squamulose.
Species growing in leaf-mold in woods. 22. *A. diminutivus.*
Species growing on manure in the open; pileus usually quite umbonate. 23. *A. approximans.*
Pileus 5–18 cm. broad.
Context becoming distinctly reddish when wounded.
Stipe 8–15 mm. thick. 24. *A. haemorrhoidarius.*
Stipe 4–8 mm. thick.
Pileus becoming reddish-brown when bruised or on drying. 25. *A. rubribrunnescens.*
Pileus not changing as above. 26. *A. eludens.*
Context not becoming distinctly reddish when wounded.
Stipe 2–6 cm. long.
Pileus with scattered fibrillose scales. 8. *A. campester.*
Pileus with spot-like scales at the center. 27. *A. Sterlingii.*
Stipe 6–15 cm. long.
Stipe 4–8 mm. thick. 28. *A. placomyces.*
Stipe 1–1.5 mm. thick.
Annulus simple; hymenophores gregarious. 29. *A. sylvaticus.*
Annulus double; hymenophores cespitose. 30. *A. subrufescens.*

1. AGARICUS COMTULUS Fries, Epicr. Myc. 215. 1838

Pileus subfleshy, campanulate to plane, 2–3 cm. broad; surface dry, appressed-silky or glabrous, white with a yellowish or rosy tint, becoming yellow on drying or when bruised, often darker at the center and with age; context thin, white, tinged with yellow, with mild taste and no characteristic odor; lamellae free, crowded, broad in front, pale-pink to purplish-brown; spores broadly ellipsoid, almost subglobose, very rounded at the ends, pale-purplish-brown under the microscope, about 4.5 x 3.5 μ; stipe tapering upward, hollow, whitish, luteous at the base, becoming yellow on drying or when bruised, 3–6 cm. long, about 4 mm. thick; annulus delicate, yellowish-white, often fugacious.

TYPE LOCALITY: Europe.

HABITAT: On the ground in open woods or in rich, grassy places.

DISTRIBUTION: New England to Alabama and west to Michigan; also in Europe.

ILLUSTRATIONS: Atk. Stud. Am. Fungi, *f. 24;* Cooke, Brit. Fungi, *pl. 533* (*552*); Fries, Ic. Hymen. *pl. 130, f. 1;* Richon & Roze, Atl. Champ. *pl. 18, f. 10–13.*

Specimens so named at Albany from Delmar and Menands seem to agree perfectly with material from Bresadola. Kauffman finds it rare in Michigan and says it needs more study. I have studied fresh specimens found here in the hemlock grove and Miss Eaton has drawn them in color.

2. **Agaricus alabamensis** sp. nov.

Pileus convex, cespitose, 3–5 cm. broad; surface smooth, of compacted fibrils, white, yellowish on drying, entire on the margin, the pellicle exceeding the lamellae by 2 mm.; context dry and spongy, white, with a distinctly sweetish taste and no odor; lamellae free, densely crowded, rather straight and narrow, cream-white to pink, then changing to brown; spores broadly ellipsoid, rounded at the ends, occasionally obliquely apiculate at the base, dark-purplish-brown under the microscope, 5.5–6.5 x 4–5 μ; stipe slightly tapering upward, solid, smooth, of compacted fibrils, white, yellowish on drying, 6–8 cm. long, 1 cm. thick; veil thick, white; annulus heavy, distant about 1.5 cm. from the pileus.

TYPE LOCALITY: Auburn, Alabama.

HABITAT: In clay soil in a plowed field.

DISTRIBUTION: Known only from the type locality.

Collected by F. S. Earle on May 19, 1901. The entire hymenophore is white and practically glabrous. The stipe is much longer than that of *A. campester* and the spores are quite different.

3. **Agaricus comtuliformis** sp. nov.

Pileus thin, slightly convex, at length expanded, 2.5–5 cm. broad; surface at first bright-yellow, nearly white at maturity, but with yellowish or brownish stains, especially near the center; margin becoming light-brown with age; lamellae free, narrow, crowded, cream-white, changing to light-pinkish-lilac, at length purplish-brown; spores broadly ellipsoid, smooth, sometimes obliquely apiculate at the base, dark-purplish-brown under the microscope, about 5 x 3.5 μ; stipe slender, not bulbous but tapering slightly upward, stringy or finally hollow within, nearly white but usually somewhat tawny and with more or less fibrous scales below the annulus, 5–7.5 cm. long, about 6 mm. thick; annulus fibrous and tomentose below, usually yellowish.

TYPE LOCALITY: Auburn, Alabama.

HABITAT: On the ground in pine woods.

DISTRIBUTION: Known only from the type locality.

Collected in quantity by F. S. Earle on July 29, 1899, and again on August 2 of the same year. It is larger than *A. comtulus,* with larger and darker spores, and the mature gills are darker. The surface of the pileus is bright-yellow in young, fresh plants, although much resembling that of *A. comtulus* in herbarium material.

4. AGARICUS SOLIDIPES Peck, Bull. Torrey Club 31: 180. 1904

Pileus fleshy, firm, convex, 2–7 cm. broad; surface squamose or rimose-squamose, white or whitish, involute on the margin; context white, unchangeable, edible, with an agreeable, sweet taste; lamellae crowded, free, dull-pink changing to dull-sepia, finally brownish-black; spores ellipsoid, 8–10 x 5–6 μ; stipe very short, equal or tapering upward and downward, glabrous, solid, white or whitish, with a slight, white veil often adhering entirely to the margin of the pileus, 2–4 cm. long, 6–10 mm. thick.

TYPE LOCALITY: Denver, Colorado.

HABITAT: In prairie pastures.

DISTRIBUTION: Vicinity of Denver.

Type collected by E. B. Sterling in June, 1902. Plants bearing this name at Albany, collected by C. F. Baker at Claremont, California, in 1909, are quite different from Sterling's plants.

5. AGARICUS PRAERIMOSUS Peck, Bull. N. Y. State Mus. 94: 30. 1905

Agaricus tabularis Peck, Bull. Torrey Club 25: 325. 1898; not *A. tabularis* Fries, 1821.

Pileus very thick, fleshy, firm, convex, 5–10 cm. broad; surface deeply rimose-areolate, whitish, the areoles pyramidal, truncate, their sides horizontally striate and their apices sometimes tomentose; context whitish, tinged with yellow; lamellae narrow, crowded, free, blackish-brown when mature; spores broadly ellipsoid, generally containing a single large nucleus, 7.5–9 x 6–7.5 μ; stipe short, thick, solid, 2.5–5 cm. long, 1.5–2.5 cm. thick.

TYPE LOCALITY: Craig, Colorado.

HABITAT: In clay soil or dumps by roadsides.

DISTRIBUTION: Colorado.

Type collected by E. Bethel in August; also collected on dumps, etc., about Leadville by E. B. Sterling on September 18, 1901. The deep clefts in the pileus are probably caused to some extent by the dry air, as I have found them in other fleshy species from Colorado.

6. AGARICUS PILOSPORUS Peck, Bull. N. Y. State Mus. 94: 36. 1905

Agaricus sphaerosporus Peck, Bull. Torrey Club 31: 181. 1904; not *A. sphaerosporus* Krombh. 1836.

Pileus fleshy, firm, broadly convex, sometimes slightly depressed in the center, 7–12 cm. broad; surface glabrous, whitish, the cuticle sometimes rimose, and the incurved young margin occasionally wavy or irregular when mature; context white, unchanging; lamellae thin, crowded, rounded behind, reaching the stipe, but free from it, rosy-red, becoming blackish-brown; spores globose or nearly so, 7.5–8 x 6–7.5 μ; stipe nearly equal, thick, firm, solid, straight or curved, whitish, 3–10 cm. long, 2–3 cm. thick, with a thin, white veil rupturing and adhering partly to the margin of the pileus and partly to the stipe, forming a slight, fringed, soon evanescent annulus.

TYPE LOCALITY: Denver, Colorado.

HABITAT: In rich soil.

DISTRIBUTION: Vicinity of Denver, Colorado.

Collected by E. B. Sterling on June 7, 1902. The types at Albany are in excellent condition.

7. AGARICUS CHLAMYDOPUS Peck, Bull. N. Y. State Mus. 94: 36. 1905

Agaricus cothurnatus Peck, Bull. Torrey Club 31: 181. 1904; not *A. cothurnatus* Fries, 1838.

Pileus fleshy, convex, with an involute margin, 5–7.5 cm. broad; surface dry, glabrous or minutely pulverulent on the margin, chalky-white; context white; lamellae crowded, free, chocolate-colored becoming black; spores subglobose, 8–9 x 7–8 μ; stipe nearly equal, white, with dense root-like fibers at the base, sheathed below by the white veil, which forms a cup-like annulus with its upper margin lacerate, 3–5 cm. long, 10–12 mm. thick.

TYPE LOCALITY: Denver, Colorado.

HABITAT: In rich soil along roadsides and paths.

DISTRIBUTION: Known only from the type locality.

Type collected by E. B. Sterling on July 25, 1902. The dried plants still retain their chalky whiteness.

8. AGARICUS CAMPESTER L. Sp. Pl. 1173. 1753

Pileus convex to expanded, 5–9 cm. broad; surface dry, silky and whitish, or floccose-squamulose and light-reddish-brown, the color being chiefly in the scales; context white, thick, solid, of mild flavor, usually not changing color when bruised; lamellae free, rounded behind, ventricose, crowded, pale-pink when young, becoming salmon-pink, and finally brown or blackish; spores ellipsoid, smooth, pale-purplish-brown under the microscope, blackish-brown in mass, about 7 x 4 μ; stipe smooth, white, cylindric, nearly equal, stuffed within, 3–6 cm. long, 1–1.5 cm. thick; annulus above or near the middle of the stipe, simple, white, often evanescent.

TYPE LOCALITY: Europe.

HABITAT: Wild in meadows and rich pastures; cultivated in caves, mines, houses, etc.

DISTRIBUTION: Cosmopolitan.

ILLUSTRATIONS: Ann. Rep. N. Y. State Mus. 48: *pl. 6;* Atk. Stud. Am. Fungi, *f. 1–8;* Barla, Champ. Nice, *pl. 27;* Bull. Herb. Fr. *pl. 134;* Cooke, Brit. Fungi, *pl. 526 (544)*; Fries, Sv. Aetl. Svamp. *pl. 5;* Gibson, Edible Toadst. *pl. 5, 6;* Gill. Champ. Fr.

pl. 129 (*572, 573*); Hard, Mushr. *f. 248, 249;* Hussey, Ill. Brit. Myc. 1: *pl. 90;* McIlv. Am. Fungi, *pl. 91, f. 4, 5;* Murrill, Ed. Pois. Mushr. *f. 11;* Mycologia 1: *pl. 3, f. 1; pl. 15, f. 4;* N. Marsh. Mushr. Book, *pl. 18, f. 1;* Palmer, Mushr. Am. *pl. 1;* Richon & Roze, Atl. Champ. *pl. 14, f. 1–15;* Ricken, Blätterp. Deutschl. *pl. 61, f. 6;* Sow. Engl. Fungi, *pl. 305*.

I have found the common edible mushroom wherever I have traveled, whether in northern or southern Europe, tropical America, or on the Pacific coast. About New York City it usually appears in late summer and early autumn. There are many varieties, which need not be discussed here. The literature of the species is extensive.

9. AGARICUS VARIABILIS Peck in McIlv. Am. Fungi 346. 1900; not *A. variabilis* Batsch, 1783

Pileus ovoid to campanulate, becoming irregularly convex or nearly plane, subumbonate, densely cespitose, 10–15 cm. broad; surface smooth, minutely fibrillose or slightly floccose, pure-white, tinged with lilac in young plants and with yellow when older; margin not striate, but sometimes split; context very thin toward the margin, white, unchanging, with a strong almond-like taste and a slight odor of musk, edible, never attacked by larvae; lamellae free, crowded, ventricose, rather narrow, pure-white when young, becoming dark-umbrinous, without the usual purplish tint; spores dark-umber-brown, without a shade of purple; stipe equal, not bulbous, white, silky, smooth above the annulus, minutely scurfy below, 5–8 cm. long, nearly 1 cm. thick; annulus ample, white, mottled with yellow scales on the under side, persistent, fixed above the middle of the stipe.

TYPE LOCALITY: Mt. Gretna, Pennsylvania.

HABITAT: In an old roofless stable.

DISTRIBUTION: Known only from the type locality.

ILLUSTRATION: McIlv. Am. Fungi, *pl. 91, f. 1.*

According to McIlvaine, who discovered the species, it grew in large quantities in an old stable from September until after frost. I have not seen the types. It is said to differ from *A. subrufescens* in being snow-white when young and tinged with light-lilac rather than with reddish-brown. If it is really a good species, a new name must be found for it.

10. AGARICUS RODMANI Peck, Ann. Rep. N. Y. State Mus. 36: 45. 1884

Pileus rather thick, firm, at first convex, then nearly or quite plane, 5–10 cm. broad; surface smooth or rarely slightly rimose-squamose on the disk, white or whitish, becoming yellowish or sub-ochraceous on the disk; context white, unchanging; lamellae crowded, narrow, rounded behind, free, reaching nearly or quite to the stipe, at first whitish, then pink or reddish-pink, finally blackish-brown; spores broadly ellipsoid or subglobose, generally uninucleate, 5–6 x 4–5 μ; stipe short, subequal, solid, whitish, smooth below the annulus, often furfuraceous or slightly mealy-squamulose above, 5–7.5 cm. long, 12–25 mm. thick; annulus variable, thick or thin, entire or lacerate, attached at or below the middle of the stipe, often appearing double with the margins projecting above and below a central groove.

TYPE LOCALITY: Astoria, Long Island, New York.

HABITAT: In grassy ground and paved gutters.

DISTRIBUTION: Canada to Virginia and west to Michigan.

ILLUSTRATIONS: Ann. Rep. N. Y. State Mus. 48: *pl. 9, f. 1–6;* Atk. Stud. Am. Fungi, *f. 17;* Hard, Mushr. *f. 250;* Kauffm. Agar. Mich. *pl. 45;* N. Marsh. Mushr. Book, *pl. 19.*

Named for Rev. Washington Rodman, who collected the types on Long Island. Specimens are to be seen at Albany also from Macoun, Wells, Wilson, Mackintosh, and Braendle. I have found it more than once about New York City. Dr. Kauffman reports it as frequent in Michigan, especially in cities, growing solitary or in clusters which sometimes contain 50 or 100 individuals.

11. AGARICUS FLORIDANUS Peck, Bull. N. Y. State Mus. 150: 50. 1911

Pileus hemispheric or campanulate, becoming nearly plane, solitary or subcespitose, 9–15 cm. broad; surface rimosely areolate or slightly strigose, becoming glabrous, whitish with a yellow or yellowish center; lamellae at first white, then pink, and finally dark-brown or blackish; spores globose or broadly ellipsoid, 5–6 x 4–5 μ; stipe easily separable from the pileus, equal or slightly thickened at the base, solid, becoming fibrous when old, whitish, 5–10 cm. long, 1.5–3 cm. thick; annulus small.

TYPE LOCALITY: DeFuniak Springs, Florida.

HABITAT: In sandy soil among grass in fields.

DISTRIBUTION: Known only from the type locality.

A number of specimens, preserved at Albany as the types, were collected by Dr. G. Clyde Fisher on March 29, 1910.

12. AGARICUS CRETACELLUS Atk. Jour. Myc. 8: 110. 1902

Pileus thin, convex to expanded, gregarious or sometimes a few joined at the base, 4–7 cm. broad; surface smooth, slightly viscid in wet weather, white with a yellowish tint at times; context white, or rarely with a pink tint, with odor and taste of almonds; lamellae narrow, free, narrowed behind, white at first, then pink, later becoming grayish-brown, not becoming black; spores 4–5 x 3 μ; stipe tapering from the enlarged base, white, smooth above the annulus, chalky-white below and covered with minute, white, powdery scales often arranged in irregular concentric rings below, solid, with the center less dense, 5–8 cm. long, 6–10 mm. thick; annulus persistent, white, smooth above, the lower surface with very fine floccose scales similar to those on the stipe from which the annulus is separated.

TYPE LOCALITY: Ithaca, New York.

HABITAT: On leaf-mold in woods.

DISTRIBUTION: New York and Michigan.

Kauffman says it is infrequent in Michigan in early autumn, growing gregariously on leaf-mold in coniferous regions.

13. AGARICUS PRATENSIS Scop. Fl. Carn. ed. 2. 2: 419. 1772

Agaricus arvensis Schaeff. Fung. Bavar. Ind. 73. 1774.

Pileus convex to expanded, 6–15 cm. broad; surface dry, subshining, glabrous or decorated with small fibrillose scales, white, becoming yellowish with age or on drying; context white, becoming yellowish, thick, highly flavored and easily digested, with an agreeable odor; lamellae free, crowded, broad, at first pallid, becoming slowly grayish-pink, and finally blackish-brown; spores very broadly ellipsoid, smooth, pale-purplish-brown under the microscope, blackish-brown in mass, about 7 x 5.5 μ; stipe glabrous, stuffed or hollow, white, becoming yellowish when bruised, often enlarged at the base, 5–10 cm. long, 8–16 mm. thick; annulus of two parts, membranous and white above, radiately split and tinged with yellow below.

TYPE LOCALITY: Bavaria.

HABITAT: In rich soil in pastures, fields, and wood borders.

DISTRIBUTION: Eastern North America; Bermuda and Mexico; also in Europe.

ILLUSTRATIONS: Ann. Rep. N. Y. State Mus. 48: *pl. 8;* Cooke, Brit. Fungi, *pl. 523* (*540*); Fries, Sv. Aetl. Svamp. *pl. 4;* Gill. Champ. Fr. *pl. 129* (*571*); Hard, Mushr. *f. 252, 253;* Hussey, Ill. Brit. Myc. 1: *pl. 76, 77;* Lucand, Champ. Fr. *pl. 162;* Murrill, Ed. Pois. Mushr. *f. 27;* Mycologia 6: *pl. 137, f. 2;* Richon & Roze, Atl. Champ. *pl. 10, f. 1–5;* Ricken, Blätterp. Deutschl. *pl. 62, f. 2;* Schaeff. Fung. Bavar. *pl. 310, 311;* Sow. Engl. Fungi, *pl. 304.*

14. AGARICUS SYLVICOLA Sacc. Syll. Fung. 5: 998. 1887

Agaricus campestris sylvicola Vitt. Descr. Funghi Mang. 43. 1832.

Agaricus bulbosus McClatchie, Proc. S. Cal. Acad. Sci. 1: 382. 1897.

Agaricus abruptus Peck, Mem. N. Y. State Mus. 3: 163. 1901; not *A. abruptus* Fries, 1852.

Agaricus abruptibulbus Peck, Bull. N. Y. State Mus. 94: 36. 1905.

Pileus convex or expanded, 5–15 cm. broad, all parts of the plant except the lamellae being white at first and becoming tinged with straw-color in places with age or when bruised, or almost entirely on drying; surface smooth, shining, glabrous or slightly silky; context white, with agreeable odor and taste; lamellae thin, crowded, rounded behind, free, pale-reddish-gray when young, becoming darker with age, and finally brown or blackish-brown with a chestnut tint; spores ellipsoid, purplish-brown, 5–7 x 3–4 μ; stipe long, equal, smooth, stuffed or hollow, bulbous, white, 8–20 cm. long, 6–15 mm. thick; veil usually double, forming a thin, membranous annulus decorated with floccose patches below.

TYPE LOCALITY: Italy.

HABITAT: In rich soil or humus in open woods and wood borders.

DISTRIBUTION: Temperate North America and Europe.

ILLUSTRATIONS: Atk. Stud. Am. Fungi, *f. 19, 20;* Cooke, Brit. Fungi, *pl. 529* (*547*); Gill. Champ. Fr. *pl. 129* (*581*); Hard, Mushr. *f. 251, 254;* Kauffm. Agar. Mich. *pl. 47;* Mycologia 6: *pl. 139;* N. Marsh. Mushr. Book, *pl. 18, f. 2, & pl. 20;* Peck, Mem. N. Y. State Mus. 3: *pl. 59, f. 1–14;* Richon & Roze, Atl. Champ. *pl. 12, f. 1–4.*

This attractive species is usually distinguished from *A. arvensis* by its smaller size and more slender shape. The abruptly bulbous stipe often seen in American specimens can hardly be considered a specific character; the same variation occurs in *A. subrufescens*, for example. There are many specimens at Albany from the eastern United States and I found it in several places on the Pacific coast, but never abundant.

15. AGARICUS MICROMEGETHUS Peck, Bull. N. Y. State Mus. 116: 44. 1907

Agaricus pusillus Peck, Ann. Rep. N. Y. State Mus. **54**: 152. 1901; not *A. pusillus* Schaeff. 1774.

Pileus fleshy but thin, convex, becoming plane, sometimes slightly depressed at the center, solitary or cespitose, 1–5 cm. broad; surface dry, silky-fibrillose or fibrillose-squamulose, grayish-brown, darker or brown on the disk, often with yellowish or ferruginous stains; context fragile, white or whitish, not changing color when wounded, with taste and odor of almonds; lamellae thin, crowded, free, grayish, soon pinkish, finally brown; spores broadly ellipsoid or subglobose, 5 x 4 μ; stipe equal or slightly tapering upward, sometimes bulbous, stuffed or hollow, slightly fibrillose, white, 1–2.5 cm. long, 2–6 mm. thick; annulus slight, often evanescent.

TYPE LOCALITY: Detroit, Michigan.

HABITAT: In various kinds of soil in shaded or exposed places.

DISTRIBUTION: New England to Tennessee, and west to Michigan and Texas.

ILLUSTRATION: Bull. N. Y. State Mus. 116: *pl. 107, f. 1–6.*

Type collected by Dr. R. H. Stevens. Other specimens are at Albany from Mackintosh, Morris, DeRouville, etc. I collected it on the Upper St. Regis; at Unaka Springs, Tennessee; and at Blacksburg, Virginia. There are specimens here also from New Jersey and Texas. The plant is not always *small*, but often about the size of the ordinary field mushroom. This is expressed in Peck's later name. Specimens from Delhi, New York, collected by Sherwood, are set aside by Peck as a variety.

16. AGARICUS ARGENTEUS Braendle in Peck, Bull. Torrey Club **26**: 68. 1899

Pileus thin, convex, becoming nearly plane, 2.5–5 cm. broad; surface slightly silky or glabrous, pale-grayish-white or grayish-brown, shining with a silvery luster when dry; margin sometimes striate, at first incurved, often revolute with age; context edible, whitish, becoming blackish when cut; lamellae crowded, free, at first brownish, becoming blackish-brown or black with age; spores broadly ellipsoid, 7–10 x 6 μ; stipe short, glabrous, solid, often narrowed toward the base, 2.5–4 cm. long, 4–8 mm. thick; annulus slight, evanescent.

TYPE LOCALITY: Washington, District of Columbia.

HABITAT: Lawns and grassy places in rich soil.

DISTRIBUTION: Known only from the vicinity of Washington.

Collected by F. J. Braendle, who says that the drying specimens emit a strong but not unpleasant odor. The species appears after rains from April to November, and is often associated with *Stropharia bilamellata.*

17. AGARICUS RUTILESCENS Peck, Bull. Torrey Club **31**: 180. 1904

Pileus fleshy, firm, convex with incurved margin, becoming nearly plane, 2.5–6 cm. broad; surface even or sometimes rimose and minutely fibrillose, dingy-white, becoming ferruginous, reddish-brown, or bay on drying; context whitish changing to reddish when cut or broken; lamellae crowded, narrow, free, reddish becoming blackish-brown; spores broadly ellipsoid, 7–8 x 5–6 μ; stipe equal or nearly so, firm, stuffed, silky, white, changing to reddish when wounded, frequently abruptly bulbous at the base, with a white veil often adhering partly to the margin of the pileus and partly to the stipe, 5–10 cm. long, 6–10 mm. thick.

TYPE LOCALITY: Denver, Colorado.

HABITAT: On manured ground in pastures.

DISTRIBUTION: Vicinity of Denver, Colorado.

Collected by E. B. Sterling on June 7, 1902. The types are well preserved at Albany.

18. AGARICUS BRUNNESCENS Peck, Bull. Torrey Club **27**: 16. 1900

Pileus thick, firm, hemispheric, becoming convex or nearly plane, gregarious, 5–10 cm. broad; surface fibrillose, sometimes slightly

squamose, bay-brown or brownish; margin extending beyond the lamellae and appendiculate from the remains of the veil; context whitish or grayish-white, unchanging, with an agreeable taste, edible; lamellae crowded, rounded behind, free, but reaching the stipe, at first whitish, then reddish-pink, finally brown; spores broadly ellipsoid or subglobose, 6–8 x 4–6 μ; stipe short, silky, stuffed or hollow, whitish, then reddish, and finally brown, 2.5–4 cm. long, 6–16 mm. thick; annulus thick, of a soft, felty texture, persistent, whitish, often striate on the upper surface with impressions of the edges of the lamellae.

TYPE LOCALITY: East Cambridge, Massachusetts.

HABITAT: In dump ground on deposits of manure and street scrapings.

DISTRIBUTION: Vicinity of Cambridge, Massachusetts.

Several good specimens are at Albany, including the types collected by Miss Helen Noyes. See Peck's description for long and interesting notes. My *A. campester hortensis,* described and figured in MYCOLOGIA for July, 1914, seems very near this species. The spores are very broadly ellipsoid to subglobose, smooth, pale-purplish-brown under the microscope, about 7 x 5 μ; appearing broader and quite different from those of typical *A. campester.* The lamellae of my plant, also, are not so pink as those of the common mushroom.

19. AGARICUS HALOPHILUS Peck, Bull. N. Y. State Mus. 94: 36. 1905

Agaricus maritimus Peck, Bull. Torrey Club 26: 66. 1899; not *A. maritimus* Fries, 1818.

Pileus very fleshy, firm, at first subglobose, then broadly convex or nearly plane, 5–20 cm. broad; surface glabrous, sometimes slightly squamose with appressed spot-like scales, white becoming dingy or grayish-brown when old; context whitish, quickly reddening when cut, edible, with an agreeable taste and a distinct odor, suggestive of the odors of the seashore; lamellae narrow, crowded, free, pinkish becoming purplish-brown with age, white on the edges; spores broadly ellipsoid, purplish-brown, 7–8 x 5–6 μ; stipe short, stout, firm, solid, equal, sometimes bulbous, white, 2.5–5 cm. long, 1.5–2.5 cm. thick; annulus delicate, slight, and easily obliterated.

TYPE LOCALITY: Lynn, Massachusetts.

HABITAT: On sandy soil near salt water.

DISTRIBUTION: Massachusetts.

The type collected by Dr. R. F. Dearborn in November is well preserved at Albany. Dr. Dearborn also found specimens at Lynn, Nahant, and Marblehead from June to December. Peck has published interesting notes in connection with his description. Mr. Oscar Hill collected it at Revere, Massachusetts, on May 29.

20. AGARICUS MAGNICEPS Peck, Bull. N. Y. State Mus. 94: 36. 1905

Agaricus magnificus Peck, Bull. Torrey Club **26**: 67. 1899; not *A. magnificus* Fries, 1838.

Pileus fleshy, thick, convex, becoming nearly plane or centrally depressed, gregarious or cespitose, 5–15 cm. broad; surface glabrous, often wavy and split on the margin, white or whitish, often brownish in the center; context 1.5–2 cm. thick in the center, thin on the margin, white, unchanging, edible, with taste and odor of anise; lamellae numerous, rather broad, crowded, free, ventricose, white becoming dark-purplish-brown with age, never pink; spores small, ellipsoid, 5–6 x 3–4 μ; stipe firm, stuffed with a cottony pith, bulbous or thickened at the base, fibrillose, striate, minutely furfuraceous toward the base, pallid or whitish, 10–15 cm. long, 2.5 cm. thick; annulus thin, persistent, white.

TYPE LOCALITY: Mount Gretna, Pennsylvania.

HABITAT: In thin woods.

DISTRIBUTION: Massachusetts, New Jersey, and Pennsylvania.

ILLUSTRATION: McIlv. Am. Fungi, *pl. 94*.

Collected by McIlvaine in August, 1898. The types at Albany are in rather bad condition because not properly dried before shipping. Sterling found it at Trenton, New Jersey, and Simon Davis in Massachusetts.

21. AGARICUS ECHINATUS Gunn. Fl. Norv. 2: 125. 1772

Pileus subfleshy, campanulate to expanded, gregarious or subcespitose, 1–3 cm. broad; surface dry, densely covered with minutely floccose to wart-like or pointed, fuliginous scales; context thin, white, becoming reddish; lamellae free, narrow, crowded, pink to dark-purplish-red or fuscous; spores ellipsoid, smooth,

dilute-ferruginous, with a purplish-brown tint under the microscope, hyaline when immature, reddish-purple-brown in mass, 4–5 x 2–3 μ; stipe equal, floccose-pulverulent and pale-fuliginous below, stuffed, white to blood-red within, 2–4 cm. long, 2–4 mm. thick; veil floccose, easily torn, forming an imperfect annulus.

TYPE LOCALITY: Norway.

HABITAT: In rich soil in greenhouses.

DISTRIBUTION: East Lansing, Michigan; also in Europe.

ILLUSTRATIONS: Ann. Sci. Nat. II. **5**: *pl. 13, f. 2* (as *Agaricus oxyosmus*); Cooke, Brit. Fungi, *pl. 395* (*422*) (as *Inocybe*); Gunn. Fl. Norv. **2**: *pl. 7, f. 6, 9, 10;* Pat. Tab. Fung. *f. 155* (as *Pholiota*); Ricken, Blätterp. Deutschl. *pl. 31, f. 6* (as *Inocybe*); Roth, Catal. Bot. **2**: *pl. 9, f. 1.*

I have authentic specimens from Europe of this very rare and interesting species reported by Dr. Kauffman as occurring in a greenhouse in East Lansing, Michigan. Saccardo places it in *Inocybe* and cites several synonyms. Patouillard classified it as a *Pholiota*. It very much resembles some species of *Lepiota* that turn red and have brown-tinted spores. Some of the figures also show a booted stipe, as in *Lepiota amianthina*.

22. AGARICUS DIMINUTIVUS Peck, Bull. Buffalo Soc. Nat. Sci. **1**: 53. 1873

Pileus thin, fragile, convex, becoming plane or centrally depressed, sometimes with a slight umbo, 2.5–4 cm. broad; surface dry, alutaceous, whitish, or pinkish-brown, adorned with small, appressed, silky, brownish scales, brownish or reddish-brown in the center; lamellae crowded, thin, free, ventricose, brownish-pink, becoming blackish-brown or black; spores ellipsoid, brown, 5 x 4 μ; stipe equal or slightly tapering upward, hollow or stuffed with a whitish pith, glabrous, whitish or pallid, 4–5 cm. long, 2–5 mm. thick; annulus thin, white, persistent.

TYPE LOCALITY: Croghan, New York.

HABITAT: Among fallen leaves or on mossy ground in woods.

DISTRIBUTION: Vermont, New York, and Michigan.

ILLUSTRATIONS: Ann. Rep. N. Y. State Mus. **54**: *pl. 74, f. 1–8;* Kauffm. Agar. Mich. *pl. 50, f. 2.*

This species has been collected from a dozen or more localities in northern New York and Kauffman says it is frequent in Michi-

gan during August and September. I got a good collection on the Upper St. Regis and sent some of it to Albany. I also found a rather small specimen at Unaka Springs, Tennessee, which was isabelline with reddish-brown disk, and had a smooth, glabrous, white stipe which was cream-colored toward the base.

23. AGARICUS APPROXIMANS Peck, Bull. N. Y. State Mus. 131: 33. 1909

Pileus thin, conic or campanulate, often obtusely umbonate, gregarious or sometimes two united at the base, 2.5–4 cm. broad; surface squamulose except on the umbo, often radiately rimose, whitish, with brownish squamules, blackish-brown or fuscous on the umbo; context white, unchanging, with a sweet and agreeable taste; lamellae thin, crowded, free, white, becoming brown or blackish-brown; spores 5–6 x 3.5–4 μ; stipe equal or tapering upward, stuffed or hollow, whitish, sometimes brownish below the annulus, 2.5–4 cm. long, 4–6 mm. thick; annulus conspicuous, persistent, simple, white, attached above the middle of the stipe.

TYPE LOCALITY: Near Trenton, New Jersey.

HABITAT: On manure.

DISTRIBUTION: Known only from the type locality.

ILLUSTRATION: Bull. N. Y. State Mus. 131: *pl. V, f. 8–14.*

Collected by E. B. Sterling on September 5, 1908. The types, which are well preserved at Albany, remind me in their shape of some species of *Lepiota.*

24. AGARICUS HAEMORRHOIDARIUS Schulz. in Kalchb. Ic. Hymen. Hung. 29. 1874

Pileus fleshy, ovoid to expanded, solitary or somewhat clustered, 5–11 cm. broad; surface dry, covered especially toward the center with rather dense, appressed, fibrillose, brownish-gray squamules; context white, changing to blood-red when broken, the odor and taste agreeable; lamellae free, approximate, crowded, rosy-flesh-colored to purplish-brown; spores ellipsoid, smooth, purplish-brown, about 6 x 4 μ; stipe subequal, fibrillose, pallid to somewhat darker with age, stuffed to hollow, solid at the base, which is sometimes bulbous, 5–10 cm. long, 8–15 mm. thick; annulus superior, ample, simple, persistent, white.

TYPE LOCALITY: Hungary.

HABITAT: About bases of trees in coniferous or mixed woods.

DISTRIBUTION: Temperate regions of North America, south to Virginia and west to California; also in Europe.

ILLUSTRATIONS: Ann. Rep. N. Y. State Mus. 54: *pl. 75, f. 1–13;* Cooke, Brit. Fungi, *pl. 531* (*550*); Gill. Champ. Fr. *pl. 129* (*577*); Kalchb. Ic. Hymen. Hung. *pl. 18, f. 1;* Richon & Roze, Atl. Champ. *pl. 16, f. 1–6.*

Peck called attention to this species in his 45th Report, his remarks being based on specimens collected under hemlocks at Menands, New York. It has since been reported from the United States in localities widely scattered. Kauffman found it infrequent in certain parts of Michigan, Harper got it in California, and I have it from Brooklyn, New York. It is easily recognized by its quick change to red when any part is bruised or broken in the fresh condition.

25. **Agaricus rubribrunnescens** sp. nov.

Pileus convex to expanded, rather thin, gregarious, reaching 8 cm. broad; surface dry, white, conspicuously ornamented from youth to maturity with slightly reddish scales, becoming reddish-brown when bruised or on drying; context thin, white, changing to reddish-brown; lamellae free, narrow, crowded, pink to dark-purplish-brown; spores ellipsoid, smooth, purplish-brown under the microscope, about $5.5 \times 3.5\,\mu$; stipe slender, equal or slightly enlarged at the base, slightly fibrillose, stuffed, white, becoming reddish-brown when handled or on drying, about 5 cm. long and 5 mm. thick; annulus simple, ample, persistent, white to slightly yellowish.

TYPE LOCALITY: Bronxwood Park, New York City.

HABITAT: About exposed roots of a living red maple tree on a lawn.

DISTRIBUTION: New York City and Long Island.

The type specimens were collected by me on September 8, 1916, in my yard, where the plant has appeared for several years. I have it also from two places on Long Island. It differs from *A. haemorrhoidarius* in its conspicuously scaly surface and smaller spores.

26. AGARICUS ELUDENS Peck, Bull. N. Y. State Mus. 139: 42. 1910

Pileus thin, ovoid, broadly conic or subcampanulate, sometimes broadly expanded, cespitose or solitary, 5–10 cm. broad; surface brown when young, becoming whitish and covered with brown, fibrillose squamules, smooth and brown on the disk; margin surpassing the lamellae when young; context white, changing to reddish when wounded; lamellae thin, crowded, narrow, free, whitish becoming bright-pink, then chocolate-brown and finally black or blackish-brown; spores subglobose or ellipsoid, 5–7 x 4–5 μ; stipe firm, nearly equal or sometimes thickened at the base, often slightly bulbous, fibrous, silky, white, distinctly hollow, white within, changing to blood-red when wounded, then to brown or black, 2.5–7 cm. long, 4–8 mm. thick; annulus thick, persistent, white, attached near the apex of the stipe.

TYPE LOCALITY: Near Trenton, New Jersey.

HABITAT: On dumping grounds.

DISTRIBUTION: Known only from the vicinity of Trenton.

ILLUSTRATION: Bull. N. Y. State Mus. 139: *pl. X, f. 6–13.*

The types were collected by E. B. Sterling on September 15, 1908, and he secured many more specimens on September 13, 1909. These are all at Albany. I see no difference between them and the type specimens of *A. placomyces,* which is known to become reddish-brown when bruised and to grow abundantly in the open at times.

27. AGARICUS STERLINGII Peck, Bull. Torrey Club 29: 73. 1902

Pileus fleshy, firm, convex or sometimes slightly depressed in the center, cespitose, 5–12 cm. broad; surface slightly silky and sometimes with appressed spot-like scales at the center, pale-brown or grayish-brown; context dingy, white or brownish, edible; lamellae thin, crowded, free, pale-brown, becoming blackish-brown with age; spores broadly ellipsoid, 6–8 x 4 μ; stipe equal or nearly so, solid or stuffed, 2.5 cm. long, 8–12 mm. thick, whitish, sometimes darker above the annulus, with a thick veil partly adhering to the margin of the pileus and partly to the stipe.

TYPE LOCALITY: New Jersey.

HABITAT: Unknown.

DISTRIBUTION: Known only from the type locality.

The type at Albany is marked "New Jersey, E. B. Sterling."

The specimens have ordinary garden loam attached to their clustered stipes. The species resembles *A. subrufescens* above, but the stipe is much shorter and thicker.

28. AGARICUS PLACOMYCES Peck, Ann. Rep. N. Y. State Mus. 29: 40. 1878

Pileus thin, at first convex, becoming flat with age, solitary, gregarious, subcespitose, or in rings, 5–8 cm. broad; surface dry, squamulose, whitish, becoming brown with age or when bruised, the disk and small scales blackish-brown; context rather thin, white or yellowish, without characteristic odor, edible; lamellae free, crowded, white, then pinkish, finally blackish-brown; spores ellipsoid or ovoid, smooth, purplish-brown under the microscope, 5–6 x 3.5–4 μ; stipe slender, smooth, containing a small pith, becoming hollow, slightly tapering upward, bulbous, white or whitish, becoming brown when bruised or on drying, 8–13 cm. long, 4–8 mm. thick; annulus large, flabby, floccose, double, persistent, fixed near the apex of the stipe.

TYPE LOCALITY: Oneida, New York.

HABITAT: On the ground in hemlock or mixed woods; sometimes in the open.

DISTRIBUTION: Temperate North America, south to Alabama and west to California.

ILLUSTRATIONS: Ann. Rep. N. Y. State Mus. 48: *pl. 9, f. 7–12;* Atk. Stud. Am. Fungi, *f. 21–23;* Bull. U. S. Dept. Agr. 175: *pl. 25, f. 1;* Hard, Mushr. *f. 255–257;* McIlv. Am. Fungi, *pl. 91, f. 3.*

In addition to the type material from Oneida, Peck had many other specimens from New York, New England, Missouri, Minnesota, and elsewhere. I found it on the Pacific coast, but not in tropical regions. It is a very symmetrical and easily recognized species, found especially under hemlock trees.

29. AGARICUS SYLVATICUS Schaeff. Fung. Bavar. Ind. 62. 1774

Pileus campanulate to expanded, gregarious, 8–11 cm. broad; surface at first grayish, then yellowish-white, covered with brown scales, rufous-fuscous on the disk; context rather thick, with agreeable odor and taste; lamellae remote, crowded, rose-colored to reddish-cinnamon; spores ellipsoid, smooth, incarnate-fulvous, 6–7 x 3.5–4 μ; stipe equal or swollen at the base, glabrous or nearly so, whitish, hollow, 6–9 cm. long, 1–1.5 cm. thick; annulus simple, distant, ample, white, flocculose.

TYPE LOCALITY: Bavaria.

HABITAT: On the ground in woods.

DISTRIBUTION: Temperate North America, Canada to Alabama and west to California; also in Europe.

ILLUSTRATIONS: Bres. Fungi Trid. 1: *pl. 90;* Richon & Roze, Atl. Champ. *pl. 18, f. 6–9;* Schaeff. Fung. Bavar. *pl. 242.*

Peck recognized two color forms, one light and the other dark. He had specimens from Canada, Vermont, Illinois, etc., as well as from New York, but most of them appear to be different from plants collected by me in Sweden and other authentic material obtained from Bresadola. The typical plant is covered above with brown scales and does not change in color as does *A. haemorrhoidarius.*

30. AGARICUS SUBRUFESCENS Peck, Ann. Rep. N. Y. State Mus. 46: 25. 1893

Pileus at first deeply hemispheric, becoming convex or broadly expanded, cespitose, 5–18 cm. broad; surface silky-fibrillose, becoming conspicuously squamulose, whitish, grayish, or dull-reddish-brown, usually smooth and reddish-brown on the disk; margin not striate, often splitting with age; context white, unchanging, with the taste of green nuts and the odor of almonds when crushed; lamellae free, narrow, crowded, at first white or whitish, then pinkish, finally blackish-brown; spores ellipsoid, smooth, dark-purplish-brown under the microscope, 6–7.5 x 4–5 μ; stipe rather long, often somewhat thickened or bulbous at the base, at first stuffed, then hollow, white and subglabrous above the annulus, floccose-fibrillose to somewhat scaly toward the base, 6–15 cm. long, 1–1.5 cm. thick at the top, twice as thick below; annulus rather distant, very ample, reflexed, double, smooth and white above, ornamented with floccose, pale-tawny scales below.

TYPE LOCALITY: Glen Cove, Long Island, New York.

HABITAT: On leaf-mold in woods and on compost heaps consisting mainly of decaying leaves.

DISTRIBUTION: New York to Michigan and southward; also cultivated.

ILLUSTRATIONS: Ann. Rep. N. Y. State Mus. 48: *pl. 7;* Bull. U. S. Dept. Agr. 175: *pl. 26;* Kauffm. Agar. Mich. *pl. 48–50.*

This splendid species grows wild and is sometimes cultivated.

The type was collected by William Falconer. Peck had specimens also from northern New York, New Jersey, Michigan, and the District of Columbia. Dr. Kauffman has made a special study of it in Michigan and pronounces it the largest species of the genus in his state. When growing on compost, it naturally attains larger proportions than when growing wild in the woods. I have specimens from Long Island six inches broad; and I found a cluster in Tennessee under red cedars in a pasture composed of individual plants five inches broad and six inches high.

DOUBTFUL AND EXCLUDED SPECIES

Agaricus Achimenes Berk. & Curt. Ann. Mag. Nat. Hist. II. **1**: 98. 1849. Described from South Carolina and also reported from North Carolina. I saw a portion of the type at Upsala, but did not make full notes on it; so I have asked Miss Wakefield to describe the specimens at Kew, which she has very kindly done as follows:

"There are three specimens of this. The largest, from which the spores drawn were taken, has a pileus measuring 9 cm. across. The other two are 4 and 5 cm. The pileus is slightly umbonate. The stalk varies from about 7 to 9 cm. in length. It is 7–8 mm. thick above, and becomes gradually thicker towards the base. A well-marked ring, with entire edge, occurs about one third of the distance from the apex. The base of the stem has some whitish mycelium adhering to it. The gills are very crowded, and appear to have been either free or adnexed. They are lightish-brown in colour. Spores pale-yellowish by transmitted light, apiculate, 11–12 x 8 μ, and with a blunt apex such as one often sees in *Coprinus* spores, as if there were a regular germ-pore there. The plant is surely a *Pholiota*."

Agaricus amygdalinus M. A. Curt. Gard. Chron. 34: 1066. 1869. Curtis did not describe the plant, but said it could be recognized at once by its taste and odor of bitter almonds. According to him, it occurred commonly in North Carolina among leaves in rich woods, etc. See *A. fabaceus*. Other species of *Agaricus* are now known to have an almond flavor.

Agaricus cretaceus Fries, Syst. Myc. **1**: 280. 1821; not *A. cretaceus* Bull. 1787. Described from plants found in manured fields in Sweden. Reported from North Carolina, Minnesota, and California by the older collectors. Peck mentioned it in his 22d Report, and there is a specimen in his collection from West Albany

so labeled, which does not entirely agree, however, with plants from Europe. Kauffman says the species differs from *A. cretacellus* Atk. in its "hollow stem, gills blackish-fuscous at maturity, and pileus at length scaly." I have an idea that it has been confused by some with *Lepiota naucina.*

Agaricus fabaceus Berk. Lond. Jour. Bot. **6**: 314. 1847. Described from Waynesville, Ohio, growing among dead leaves in woods. Reported from South Carolina by Ravenel and from other localities by various collectors. Dr. Farlow suggested it might be the same as *A. amygdalinus* Curt. and *A. subrufescens* Peck. Miss Wakefield writes me from Kew as follows:

"The type from Lea, Ohio, consists of three specimens, in fairly good condition. The pileus is 10 cm. across in the largest, 5 cm. in the smallest, and umbonate. The stalk is somewhat swollen at the base, and 11 cm. long in the large specimen. Gills crowded, dark, either free or adnexed. No ring now present. Spores dark-brown by transmitted light, about 6–7 x 3.5–4 μ."

Agaricus flavescens (Gill.) Sacc. Syll. Fung. **5**: 1000. 1887. Two collections so named at Albany are different and rather poorly preserved. *A. sylvicola* becomes yellowish with age or on drying and may have been confused by some American collectors with *A. flavescens.*

Agaricus foederatus Berk. & Mont. Syll. Crypt. 121. 1856. Described from plants collected in July in a pasture near Columbus, Ohio, by Sullivant. The description suggests a species of *Stropharia,* as Morgan has claimed. There is no specimen at Kew.

Agaricus xylogenus Mont. Syll. Crypt. 122. 1856. Described from plants collected near Columbus, Ohio, by Sullivant. See notes in *Mycologia* **6**: 151. 1914, and in N. Am. Fl. **10**: 64. 1914.

NEW YORK BOTANICAL GARDEN.

SOME CHARACTERS OF THE SOUTHERN TUCKAHOE

John A. Elliott

(With Plates 17 and 18)

The literature on *Pachyma cocos* is so abundant and covers so long a period that even a complete bibliography would take considerable space. Regardless of this fact, the fungus still remains a mycological mystery about which even the smallest additional information is likely to be of interest.

Although work had previously been done (5) toward establishing the purely fungoid nature of the tuckahoe, Prillieux (6) apparently deserves the credit of having first definitely stated that it was made up entirely of fungous elements. Fischer (4) carried the work considerably further in showing rather conclusively how the different types of tissues arose. The relation between the tuckahoe and the roots to which it was usually found attached has been variously explained. The early observers considered it entirely an outgrowth of the roots on which it was found. Berkeley (1) thought it an abnormal development of the root, induced, perhaps, by the action of a fungus. Fischer's conclusion that the tuckahoe is parasitic (4) in its nature has apparently not been questioned; but while there is no doubt that the fungus is destructive to woody tissues, from the information collected by Gore (5) it would seem that the fungus is a saprophyte, although it may be a facultative parasite as well.

The chemical nature of the tuckahoe was the first of its characters satisfactorily established. Torrey (7) reported the first analysis of the tuckahoe in 1821, stating that it was made up largely of a vegetable principle, which he called "sclerotin," and following Braconnet's (3) work on pectic acid, Torrey (8) identified his "sclerotin" as the pectic acid of Braconnet.

The generic relations of the tuckahoe have always been a matter of interest and speculation. There is little object in going into

history of the various guesses by those who had little or no knowledge of mycology. Gore's discussion (5) includes a report by W. H. Seaman on the botanical nature of tuckahoe, in which Seaman states that he would expect spores to develop from the dark mycelium directly beneath the cortical layer. Nothing, however, is suggested as to the possible generic relation of the fungus. Fischer (3), while he does not go into an exhaustive study of the possible generic relations, suggests, from analogy, that the tuckahoe probably gives rise to a polypore. Bommer (2) took up the study at the point Fischer left off and, after a comparative study of many sclerotia-forming fungi, suggested that *Pachyma cocos* may either be sterile or may be connected with the genus *Lentinus*.

Observations I have made on the tuckahoe have revealed some additional characters which may throw some light on the generic position and the habits of the fungus. Three different specimens have been sent to the Arkansas laboratory. The first was a small specimen with a smooth coat and showing no apparent connection with any foreign object. The other specimens were quite large and, according to the workmen who had dug them, were attached to sumac roots. They were of the rough-coated type generally described (Pl. 17, f. 1). One had been cut off of what was apparently a disintegrating root, the other had a living root slightly attached to one side by an overgrowing rhizomorph. The specimens were cut in halves and tissues from various parts examined microscopically by Prof. H. R. Rosen and myself. Our observations at this time revealed one point that so far as I have been able to ascertain has not been reported previously—*i.e.*, that the finer fungous threads quite commonly show the typical, clamp connections found in basidiomycetes (Fig. 1).

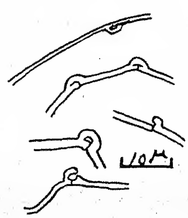


Fig. 1. Mycelium from *Pachyma cocos* showing clamp connections.

With the purpose of inducing the sclerotium to produce a carpophore, one half of the larger specimen was placed on a glass surface under a bell jar and kept in the laboratory throughout the summer. No attention was given it beyond keeping it moist. The cut surface, which had been placed next to the glass, promptly produced a dark-brown, felty cortex which, as it aged, became more and more like the coat which covered the original surface (Pl. 17, f. 2, and pl. 18, f. 3). After this coat was formed, no change having been noted for several weeks, the sclerotium was placed in moist sand between some cotton plants on a greenhouse bench. It was again placed with the newly cut surface down. The only attention paid to the fungus during the winter was to uncover occasionally the upper half to discover any possible outgrowths. As in several months no change could be observed in the sclerotium aside from a slight yielding under pressure, it was dug out, upon which several interesting things were revealed. A rather large, black, root-like outgrowth had been put out from the lower surface of the sclerotium at the edge of the cut surface (Pl. 18, f. 4). This had spread out fan-wise as it reached the wood of the bench and spread over the surface of the wood for some distance. It seemed to be very securely attached to the pine-wood bench. Other strands had produced cylindrical sheaths covering two cotton roots which came in their way.

In detaching the fungus from the bench, the main rhizomorph was broken and several large drops of a milky fluid were exuded from the broken ends, principally from the one attached to the main sclerotium. This fluid was odorless and tasteless, as far as could be determined. One of the fungous sheaths surrounding the cotton roots was removed to observe, if possible, any effect on the root. Except for being a little brighter colored (supposedly because it was cleaner) than the parts of the root outside of the sheath, no effect on the root could be observed. The sclerotium was again placed in its position on the greenhouse bench, where, after several months, it was found that no further development had occurred, and that the rhizomorph had disintegrated (Pl. 18, f. 3). The sclerotium was again cut in two for examination. It had much the same appearance as when first found, except that it

was markedly less dense in structure, indicating a probable exhaustion of much of the stored food material. An attempt was made to culture the fungus from the interior of the mass by removing portions of the tissues aseptically and planting them on cornmeal agar. Plantings from the center of the mass failed to germinate, but a rapidly growing mycelium developed from sections cut from near the cortex. Cultures of this mycelium were transferred to flasks of cornmeal agar, where they quickly covered the surface of the agar with a dark-brown, thick, sterile, felty growth. It made no further development.

The exudation of milky juice from the broken rhizomorph suggested the presence of lactiferous ducts and glands in the sclerotium, and sections were accordingly cut from various parts of the structure, embedded in paraffin, sectioned, and stained for more detailed microscopic study of its morphology. In addition to the

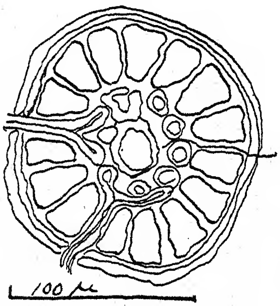


Fig. 2. Camera lucida drawing of a glandular body in *Pachyma cocos* showing entering ducts. This was one of the more regular forms.

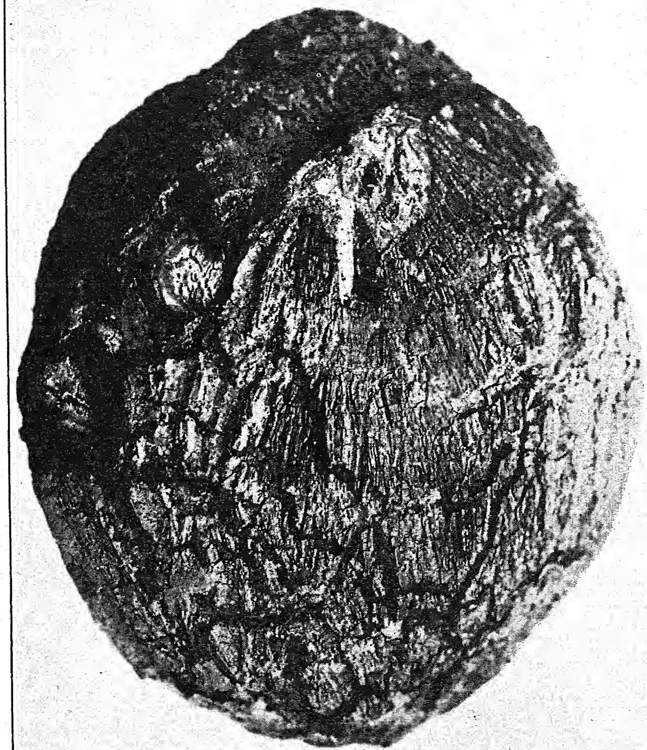
variously shaped fungous elements which have been reported by Prillieux, Fischer, Bommer, and others, structures were found which would seem to be lactiferous ducts and glands. These were near the cortex in all cases observed. The ducts were thin-walled; large (10 μ) in comparison to the hyphal threads (2–4 μ) and usually ended in structures which were interpreted as glands (Fig. 2). With Flemming's triple stain, the fungus took a uniform light-blue stain throughout. However, scattered along the inside of the supposedly lactal glands and ducts were granules and droplets which took the safranin stain quite consistently. These drop-

lets were interpreted as being the remains of the lactic fluid which the glands had secreted.

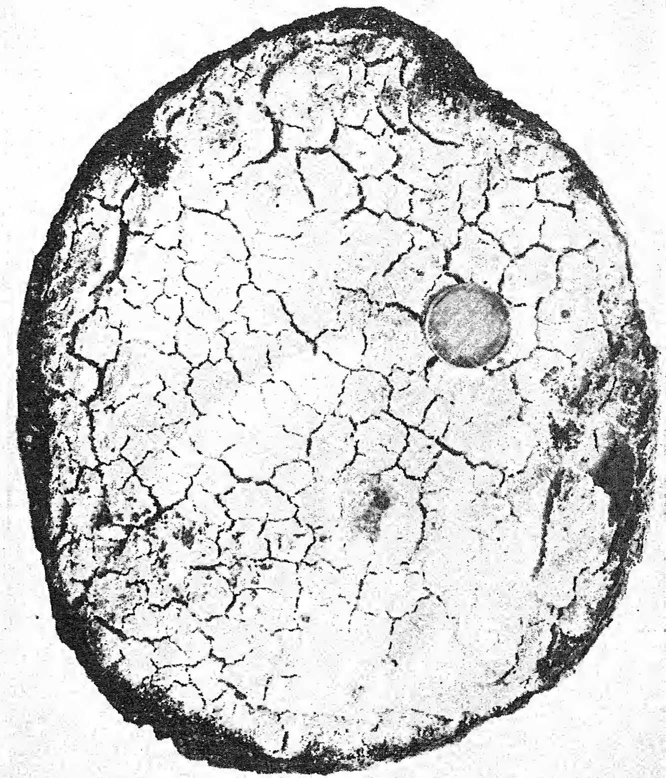
The detailed structure of these glandular bodies is rather difficult to make out and is different in different specimens. Two constant features are the presence of an outer wall of several layers which have the appearance of the striations of a starch grain and the presence inside the body of a number of "ducts" which can be seen to penetrate the wall and apparently ramify throughout the interior. The structure within the striated walls is quite variable. While most of the large elements in the tuckahoe are homogenous bodies with no apparent striations whatever, an occasional body may be found in sectioned material which is markedly striated. The bodies interpreted as glands may be these large striated bodies partly dissolved by the action of the ducts entering them. They do, however, differ considerably from most of the larger elements of the tuckahoe, in their regularity of form. In looking over a slide they may be very readily located by following the path of the ducts, which invariably lead in their direction.

The presence of the milky juice and the lactiferous ducts and glandular bodies may be of some generic significance. However, it would seem essential, in a sclerotium of the size and nature of the southern tuckahoe, if the stored material is to be transported rapidly for the production of a fruiting body or any other purpose, that some system of glands and ducts be developed.

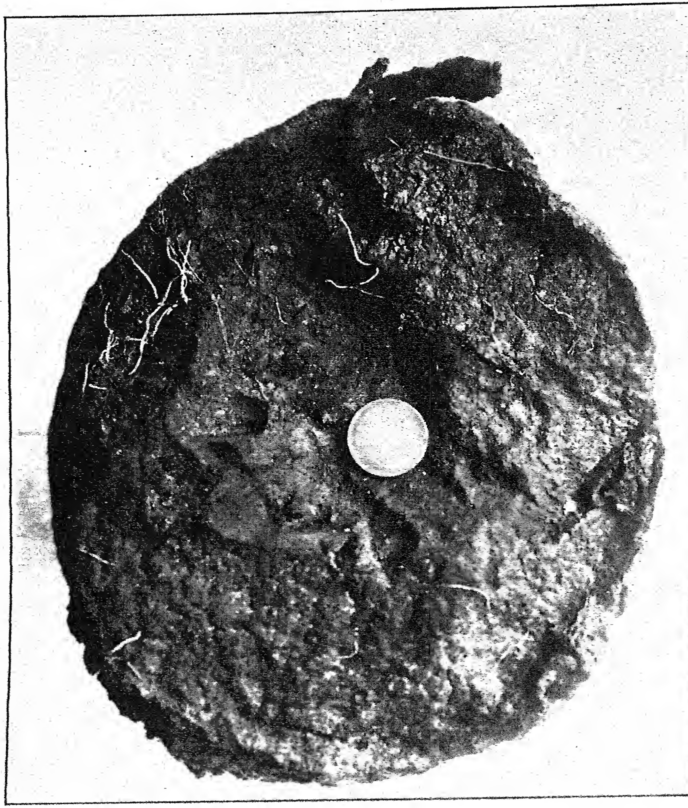
The behavior of the fungus in the greenhouse bench probably has no significance in determining its possible parasitism. The mycelium was apparently penetrating the pine boards in the bottom of the bench; also, it had overgrown two cotton plant roots without any apparent injury to them. Its failure to attack the cotton roots does not prove that the fungus can not attack living, pine roots, as has been so often affirmed. With suitable equipment, it should not be difficult to follow for a considerable period the development of the tuckahoe and its possible parasitic relation to various hosts. The idea, commonly prevalent among the earlier observers, that the whole sclerotium was covered with the bark of the root attacked, which idea led to the conclusion that the growth was an abnormally developed root, is easily understood. The cortex has much



1. Exterior of Pachyma cocos



2. Interior of Pachyma cocos



3. SHOWING NEW CORTEX

4. SHOWING RHIZOMORPH

the appearance of the roughened bark of a large root, or, more nearly, of the bark of a tree trunk or branch, and for the same reason. A microscopic study of the cortex of the sclerotium may show little, if any, of the original wood or bark of the host, but the fungous cortex will be thicker and denser in some places than in others. The old cortex evidently stretches and cracks as the sclerotium enlarges, the newly developed cortex filling in the gaps between the older portions, making the surface rough and uneven.

The writer is much indebted to Mr. H. R. Rosen and Prof. E. A. Burt, of the St. Louis Botanical Garden, and Miss E. B. Hawks, of the United States Department of Agriculture Library, for references to literature, and especially to Mr. Rosen for his interest and assistance in the study.

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EXPLANATION OF PLATES 17 AND 18

Fig. 1. External view of *Pachyma cocos* Fries, showing roughened bark-like cortex.

Fig. 2. Cut surface of *Pachyma cocos* after drying about 24 hours. The homogenous character of the interior is evident. (The coin is a one-cent piece.)

Fig. 3. New cortex grown on cut surface of a tuckahoe (shown in Fig. 2), and remnant of rhizomorph shown in Fig. 4.

Fig. 4. Rhizomorph produced by a tuckahoe growing on a greenhouse bench. (This negative was scratched.)

CULTURES OF HETEROECIOUS RUSTS, 1920–21

W. P. Fraser

A few culture experiments made in 1920 and 1921 seem worth recording, as they extend the aecial host range of *Puccinia subnitens* Diet., the well-known pluriverous rust. They also clear up the confusion that has prevailed in regard to the connections of the aecia on *Glaux maritima* L.

Telial inoculations were made by suspending germinating telia above the potted host plants which had been sprayed with water by an atomizer. The plants were placed in an infection box for about 48 hours and then removed to the greenhouse. In every experiment several checks were kept which remained free from infection.

Puccinia Distichlidis Ellis & Ev.

Aecia were found to be locally abundant on *Glaux maritima* L. near Saskatoon in the spring of 1920. Field observations left little doubt that they were connected with *Puccinia Distichlidis* on *Spartina pectinata* Bosc. Telial material on this host was collected and gave excellent germination. Inoculations were made in the greenhouse on two pots of *Glaux maritima*. Pycnia developed on both, followed by abundant aecia. The experiments were repeated in 1921, on May 27, on two pots of *Glaux maritima*. Pycnia and aecia followed in abundance. Inoculations of a third pot on June 2 were also successful. Dr. Arthur studied the material from the field collections and cultures of 1920, and as a result has listed *Glaux maritima* as an aecial host of *P. Distichlidis*. (See N. A. F. 7: Part 4, 317.)

Arthur (Mycol. 8: 136. 1916; 9: 299. 1917) has shown that *Puccinia Distichlidis* on *Spartina Michauxiana* Hitchc. has aecia also on *Stieronema ciliatum* (L.) Raf. Field observations made at Brandon, Man., indicate that this is also true in western Canada. This culture adds another host species to that established by Arthur.

Plowright in 1890, using telial material of *Uromyces Scirpi* Burr. from *Scirpus maritimus* L. in England, successfully infected *Glaux maritima*. This work has not been confirmed in America, but American aecia in *Glaux* have been referred to that species. This experiment and the one described below shows that aecia on *Glaux* may belong to *P. Distichlidis* or *P. subnitens*.

UROMYCES ALOPECURI Seym.

Inoculations were made on a pot of *Alopecurus aristulatus* Michx. with aeciospores from aecia on *Ranunculus apetalus* Farr, collected by Mr. A. McNeil. Uredinia and telia followed. This confirms the results of cultures in 1918. (See Mycol. **11**: 129. 1919.)

PUCCINIA SUBNITENS Diet.

Field observations near Saskatoon in 1920 indicated that aecia on *Glaux maritima* were connected with *Puccinia subnitens* or *Distichlis stricta* (Torr.) Rydb. Inoculations with germinating teliospores were made on two pots of *Glaux maritima* on June 26. Pycnia appeared in about a week, and were followed by abundant aecia. The experiments were repeated in 1921. Inoculations were made on different potted plants on May 27, June 2 and 9. Heavy infection followed in all the plants inoculated, both pycnia and aecia developing abundantly. Inoculations on *Dodecatheon pauciflorum* (Durand) Greene failed to produce infection.

Aecia from the cultures and field collections of 1920 were sent to Dr. Arthur, who was then preparing the manuscript of *North American Flora* covering the heteroecious grass rusts. He studied the field collections and the cultures of aecia and reported that they agreed in every respect with those of *P. subnitens,* and pointed out that the outer walls of the peridial cells were much thickened as in the typical aecia of *P. subnitens*. In this respect they differed markedly from the aecia on *Glaux* belonging to *P. Distichlidis*. He listed the field collections on *Glaux* from Saskatchewan under *P. subnitens* Diet. (*Dicaeoma Sarcobati* (Peck) Arth.). (See N. A. F. **7**: Part 4, 305.)

The aecia of *P. subnitens* on *Glaux* were long and slender and differed in this respect from the aecia of *P. Distichlidis* on the

same host, which developed under exactly the same conditions in the greenhouse. The latter were short and cupulate and much paler in color. The field collections also showed the same differences.

Observations in 1920 and 1921 in the same region also indicated the connection of aecia on *Plantago eriopoda* Torr. with *Puccinia subnitens* on *Distichlis stricta* (Torr.) Rydb. Inoculations were made on three pots of *Plantago eriopoda* on May 27. Heavy pycnial infections appeared on all the plants, followed by aecia. The aecia showed the characters of *Puccinia subnitens,* the outer wall of the peridial cells being much thickened. The aecia were not so long as those of *P. subnitens* on *Glaux maritima* grown in the greenhouse at the same time and under the same conditions, nor was the production of aecia so abundant.

Many cultures by Arthur and by Bethel (Phytopath. 7: 92. 1917; 9: 193. 1919) have shown that *P. subnitens* is a species with a large number of aecial hosts in many families. Arthur, in the *North American Flora,* lists twenty-one families (including *Glaux maritima*). These experiments have added two new families to the list of aecial hosts. Arthur (Mycol. 9: 306. 1917; Bot. Gaz. 25: 17. 1903) has shown that *Uromyces seditiosus* on *Aristida* has aecia on several species of *Plantago.* These experiments show *P. subnitens* also has aecia on *Plantago eriopoda.*

SUMMARY OF NEW RESULTS

Puccinia Distichlidis Ellis & Ev. Inoculations with teliospores from *Spartina pectinata* Bosc. produced pycnia and aecia on *Glaux maritima* L.

Puccinia subnitens Diet. Inoculations with teliospores from *Distichlis stricta* (Torr.) Rydb. produced pycnia and aecia on *Glaux maritima* L. and *Plantago eriopoda* Torr., but failed to infect *Dodecatheon pauciflorum* (Durand) Greene.

SUMMARY OF RESULTS CONFIRMING PREVIOUS WORK

Uromyces Alopecuri Seym. Inoculations with teliospores from *Ranunculus apetalus* Farr infected *Alopecurus aristulatus* Michx.

DOMINION LABORATORY OF PLANT PATHOLOGY,
UNIVERSITY OF SASKATCHEWAN,
SASKATOON, SASK.

NOTES AND BRIEF ARTICLES

[*Unsigned notes are by the editor*]

Dr. A. H. W. Povah, recently connected with the Alabama Polytechnic Institute, has been appointed assistant professor of botany at Northwestern University.

Dr. Arthur S. Rhoads, formerly Assistant in Forest Pathology of the U. S. Bureau of Plant Industry, and more recently of the Office of Cereal Investigations and the Office of Fruit Disease Investigations of the same bureau, has resigned to accept the position of pathologist at the Missouri State Fruit Experiment Station at Mountain Grove, Missouri.

A list of smuts and rusts prepared by Mrs. Flora W. Patterson and her assistants has been issued as Department Circular 195 of the U. S. Department of Agriculture.

Septocladia dichotoma, a new genus and species of water-molds, was described and figured by Coker and Grant in the *Journal of the Elisha Mitchell Scientific Society* for March, 1922.

Two fine specimens of *Clavaria subcaespitosa* Peck, representing different stages of the plant, have been sent to the mycological herbarium by Miss Ann Hibbard, who collected them at Ellis, Massachusetts, the type locality, on August 23, 1921. In a letter accompanying the plants Miss Hibbard remarks: "The spores in these specimens are rough, but Dr. Burt, to whom I have also sent specimens, writes me that spores of the type specimen at Albany are rough, although Mr. Peck made no mention of that fact in his published description of the species."

The Imperial Bureau of Mycology has undertaken the publication of a monthly abstracting journal, the *Review of Applied Mycology,* for the purpose of supplying, month by month, a summary of the work published in all countries on the diseases of plants and various other aspects of economic mycology. The first number was issued in January, 1922, and a volume of between four and five hundred pages annually is expected. All communications respecting the publication should be sent to the Editor, Imperial Bureau of Mycology, Kew, Surrey.

In a recent article by Professor Bruce Fink under the heading of "An Addition to the Distribution of a Rare Fungus" (MYCOLOGIA, Vol. XIV, p. 49) it is noted that a collection of *Tylostoma verrucosum* made at Oxford, Ohio, in 1921 seemed to be a fourth locality for this fungus. Some twenty of these fine plants were found growing gregariously on very rich leaf-mold on the Indiana University campus, Monroe County, Indiana, October 2, 1911. This was published in the Indiana Academy of Science, 1911, p. 351.—*J. M. Van Hook.*

The spores of *Schizophyllum commune* are shown by J. F. Adams in *Torreya* for November–December, 1921, to be slightly pinkish in mass, and the suggestion is made that it belongs, therefore, in the Rhodosporae rather than in the Leucosporae. Several species belonging to *Pleurotus,* a white-spored genus, also have rosy-tinted spores. Nature does not always draw her lines as definitely as man would like. Mr. Adams's suggestion that *Schizophyllum* might be used by students for spore prints during the winter is an excellent one.

The Report of the New York State Botanist for 1919, distributed in February, 1922, contains a list of about 20 fungi new to the state; a description of the new species *Microdiplodia populi* Dearness from Colorado; an index to the New York species of *Mycosphaerella,* 47 in number; an article on new or noteworthy species of fungi, by Dearness and House; and studies in the genus *Inocybe,* by Kauffman, briefly noticed in the March number of

Mycologia. New species described by Dearness and House are: *Diaporthe menispermi; Diaporthe triostei, Didymella agrostidis, Gloeosporium acutiloba, Gnomoniopsis acerophila, Leptosphaeria collinsoniae, Leptothyrium conspicuum, Phomopsis impatientis, Ramularia eamesii, Saccardinula alni, Septoria acetosella, Septoria hieracicola, Stagonospora meliloti,* and *Venturia fimbriata.*

Volume 6, part 1, of *North American Flora* consists of a monograph of the genus *Phyllosticta* by Fred J. Seaver. The work is largely a compilation of the species described and reported for North America—*i.e.,* no attempt has been made to culture out the species in order to determine their life histories, although the gross morphology has been studied as carefully as the available material will permit. Wherever the perfect stage is known, it has been indicated in a note supplementary to the descriptions. In order to comply with the form, a key has been arranged. On account of the difficulty, however, of constructing a satisfactory key for such a large genus in which the specific differences are so slight, the general rule for *North American Flora* has been modified and a host index supplied for the genus. An attempt has been made to correct host determinations where material is adequate, but unfortunately many of the specimens are so fragmentary that it has been necessary to accept the host determinations made by the collector. The entire work consists of 84 pages of text and was issued early in April, 1922.

MACBRIDE'S NORTH AMERICAN SLIME-MOULDS[1]

Both student and nature lover will welcome the appearance of Professor Macbride's long-looked-for revision of the North American Slime-Moulds, for in spite of its obscurity this group of organisms is of like interest to both the professional botanist and the amateur. Standing as they do on the border line between animals and plants, or, as suggested by the author of the book, perhaps outside the pale of either, they furnish a most fertile field for the speculation of the student. Consisting, as they do in their

[1] Macbride, T. H. North American Slime-Moulds, pp. i–xvii, 1–299. The MacMillan Co., New York, 1922.

vegetative stage, of a naked mass of liquid protoplasm which, unlike all other liquids, defies the laws of gravity and persistently flows uphill instead of down, these organisms never cease to arouse the interest of the nature student, provided their eyes are keen enough to detect them at all or some one has directed their attention to them.

Add to this the varied and fantastic shapes which are assumed by the fruiting stage of the slime-moulds and which adorn the ugly surface of rotting logs with minute feathers and cushions of the most delicate structures and beautiful colors, and it is difficult to select any group of either animals or plants which can furnish a more fascinating subject for observation and study. Only one other thing is necessary to make this work a great success, and that is the personality of the man behind the book, which, while it may shine out through the printed page, can never be fully appreciated unless one, like the writer, has come into personal contact with its author in the classroom.

In matters of nomenclature the author has not followed hard and fast rules, but has apparently attempted to use the oldest recognizable specific names without regard to rule or date. He has attempted to correlate the work of America and Europe so that the species common to the two continents will appear under the same names in the standard American and European works, where the identity can be agreed upon. One other very commendable feature of the book is the extensive notes and observations which supplement the technical descriptions.

The illustrations consist of twenty-three plates as compared with eighteen in the old edition. The plates are made in half-tone from photographs and drawings showing habitat sketches and microscopic details. The drawings are very well done, the sculpturing of the spores and capillitium being so well shown that they can not fail to arouse in the reader a desire to see actually and know more of these wonderful organisms. No colored illustrations are used. A copy of this book should be in the hands of not only every botanist, but also of every nature student who loves to ramble in the woods and fields in search of natural objects of interest.

F. J. SEAVER

Spores of Neopeckia and Herpotrichia

MYCOLOGIA

VOL. XIV SEPTEMBER, 1922 No. 5

STUDIES IN TROPICAL ASCOMYCETES—I

NEOPECKIA DIFFUSA AND HERPOTRICHIA ALBIDOSTOMA

FRED J. SEAVER

(WITH PLATE 19)

Through our own collections and the contributions or exchanges of others, an increasing amount of tropical material is continually coming to hand and it is the intention of the writer to publish from time to time notes on the more interesting species under the above general title. It is not the intention to restrict these notes to those species which are found in the tropics only but to include any forms which are of especial interest even though they may be cosmopolitan in their distribution as are the two which make up the subtitle of the present paper. These although frequently collected in the tropics were not originally described from tropical material, neither are they confined thereto, but have a very wide range of distribution.

On several occasions the attention of the writer has been called to the confusion which has resulted from the external similarity of the two above-named species while internally they are so different that they have been placed in different genera. As to the merits of the generic separation, the reader may judge for himself, the present paper being an attempt to emphasize the specific differences of the two species and to note some of the apparent synonyms and the wide range of distribution of the plants.

Several years ago the writer took the time to make microscopic examination of the spores of all of the specimens in the collection

[MYCOLOGIA for July (14: 173–234) was issued July 29, 1922]

of the New York Botanical Garden under these names in order to separate the two species and found no difficulty in making the separation on microscopic characters. Chardon,[1] however, in his recent paper on the Pyrenomycetes of Porto Rico calls attention to the fact that Stevenson in his list of Porto Rican Fungi refers one of his numbers to *Herpotrichia albidostoma* and the other three to *H. diffusa,* while all of them agree in spore characters with the former. This is a fair illustration of the confusion which has always existed where determinations are made on superficial examination rather than on a detailed study of the spore characters, although the importance of this kind of work will scarcely be appreciated until one has taken the trouble to make comparative studies of a large number of specimens. Another fact which has been emphasized is the constancy of spore characters in specimens collected over a wide range of distribution including both temperate and tropical species.

Some of the gross characters common to the two species which are responsible for the existing confusion are: the subiculum of brown mycelium which is usually present but may be entirely wanting in older or weathered specimens, the light-colored usually reddish ostiola which are conspicuous but which may become discolored with age, and the gregarious or often rather congested habit of growth. The differences in spore characters are: size, form, color and septation. Since these characters, except color, can be shown better by illustration than by description, the reader is referred to the accompanying plate for illustrations of the spores of the two species made from specimens collected over a wide range.

Both species have been referred to the genus *Herpotrichia* and a word ought to be added regarding the generic position of *Neopeckia diffusa.* In 1912 while working over these specimens in our collections the writer had a rather extended correspondence with Peck regarding the generic position of *Herpotrichia rhodospiloides* Peck, maintaining that this species belonged to the genus *Neopeckia* rather than *Herpotrichia.* Later study showed this species to be identical with *Herpotrichia diffusa* which had already been

[1] Mycologia 13: 279–300. 1921.

placed in the genus *Neopeckia* by Starback,[2] thus confirming the contention of the writer. *Neopeckia* differs from *Herpotrichia* in that the spores are never more than 1-septate while in the latter they show a tendency to become more than 1-septate, although in the species under discussion they are only occasionally so.

We give below a description of the two species with a list of the apparent synonyms of each and some idea of the wide range of distribution. Attention is especially called to the close similarity in size and form of the spores from specimens collected in widely separated localities. While the specimens often vary in the amount of tomentum present, color, etc., the spores remain constant in size and form and without the spore characters it would be very difficult, if not impossible, to decide in many cases on the identity of the species.

NEOPECKIA DIFFUSA (Schw.) Starb. Bih. Sv. Vet.-Akad. Handl. 19 (3)[2]: 30. 1894

Sphaeria diffusa Schw. Trans. Am. Phil. Soc. II 4: 210. 1832.
Sphaeria rhodomphala Berk. Hooker's Jour. Bot. 4: 313. 1845.
Herpotrichia rhodomphala Sacc. Syll. Fung. **2**: 212. 1883.
Amphisphaeria subiculosa Ellis & Ev. Jour. Myc. **2**: 103. 1886.
Byssosphaeria diffusa Cooke, Grevillea **15**: 81. 1887.
Amphisphaeria diffusa Sacc. Syll. Fung. **9**: 747. 1891.
Herpotrichia rhodospiloides Peck, Bull. Torrey Club **36**: 154. 1909.

Perithecia gregarious, globose, seated on or involved in an effused, thin, black tomentum, subglabrous and dull reddish-brown or grayish at the apex, sometimes entirely black; ostiola obscurely lacerated; asci clavate or subcylindric, 60–100 μ long, 10–12 μ broad; spores crowded or subdistichous, oblong or fusoid, straight or slightly curved, 1-septate, usually with one or two oil-drops in each cell, hyaline, becoming pale-brown, 6–8 x 16–20 μ.

On dead wood and twigs.

TYPE LOCALITY: Bethlehem, Pennsylvania.

DISTRIBUTION: North America; Guadeloupe; Trinidad.

ILLUSTRATION: E. & P. Nat. Pfl. **1**: 396, *f. 255, H–J.*

EXSICCATI: N. Am. Fungi *2130* (as *Amphisphaeria subiculosa*), *2540* (as *Herpotrichia diffusa*); Fungi Columb. *2835* (as *Herpo-*

[2] Engler-Prantl, Nat. Pfl. 1[1]: 396.

trichia rhodospiloides), *3632* (as *Herpotrichia diffusa*); Baker Fungi Malayana *60*; Rab.-Wint.-Paz. Fungi Eu. *3960* (as *Herpotrichia diffusa*).

Herpotrichia albidostoma (Peck) Sacc. Syll. Fung. 9: 857. 1891

Sphaeria albidostoma Peck, Ann. Rep. N. Y. State Mus. 32: 51. 1879.

Herpotrichia incisa Ellis & Ev. Proc. Acad. Sci. Phila. 1893: 130.

Perithecia numerous, subcrowded, subglobose, seated upon or involved in a black or blackish-brown tomentum, the ostiolum naked, not prominent, whitish when moist, darker when dry; asci cylindric or subcylindric; spores biseriate, oblong-fusoid, at first 1-septate, constricted at the septum, later often becoming indistinctly 3–5-septate, colorless, becoming pale-yellowish or brownish, 8–10 x 35–45 μ.

On dead wood or branches (type on *Acer spicatum*).

Type locality: Catskill Mountains, New York.

Distribution: North America; Porto Rico; Trinidad.

Exsiccati: C. L. Smith, Central American Fungi I (as *Herpotrichia diffusa*).

Nearly all of the specimens examined of this species have been distributed under one of the names applied to the preceding species, especially *Herpotrichia diffusa*.

Explanation of Plate 19

Neopeckia diffusa (Schw.) Starb. (spores)

Fig. 1. Specimen from the Schweinitz collection, no locality given.

Fig. 2. Arkansas, "Fungi Columbiani" *2835* (as *Herpotrichia rhodospiloides* Peck).

Fig. 3. Baker, "Fungi Malayana" *60*.

Fig. 4. Trinidad *2985*, collected by the writer.

Fig. 5. Trinidad *3084*, collected by the writer.

Fig. 6. Guadeloupe *260*, collected by P. Duss.

Herpotrichia albidostoma (Peck) Sacc. (spores)

Fig. 7. Specimen from the Peck collection, apparently cotype, New York.

Fig. 8. Porto Rico *5586*, collected by J. A. Stevenson.

Fig. 9. Trinidad *3128*, collected by the writer.

Fig. 10. "Central American Fungi" *7*, distributed by C. L. Smith.

Fig. 11. Louisiana, Langlois *2463* (as *Herpotrichia duffusa* var. *rhodomphala* Berk.).

Fig. 12. Canada *1810*, collected by John Dearness (as *Herpotrichia incisa* Ellis & Ev.).

LIFE HISTORY OF AN UNDESCRIBED ASCOMYCETE ISOLATED FROM A GRANULAR MYCETOMA OF MAN

C. L. Shear

(With Text Figures 1–3)

In March 1921 we received from Dr. Mark F. Boyd of the Medical Department of the University of Texas, Galveston, Texas, cultures of a fungus showing perithecia and conidia for identification. This fungus was isolated from a lesion in a diseased ankle of a negro in Texas. The clinical history of this case with a general description of the organism has recently been published by Doctors Boyd and Crutchfield.[1] In brief the history of the case and of the organism is as follows:

Some twelve years ago the patient while barefooted ran a thorn into the sole of his foot. The thorn was removed and the wound apparently healed. About three months later the ankle began to

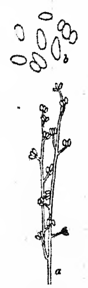


Fig. 1. *Allescheria boydii.* *a*, Cephalosporium stage, conidiophores and conidia × 277; *b*, conidia, × 530.

pain and became swollen. The swelling became soft and finally ruptured, discharging bloody pus. The lesions healed over temporarily, but continued to break at intervals. Soon after the pa-

[1] Boyd, Mark F., & Cutchfield, Earl D. Contribution to the Study of Mycetoma in North America. Am. Jour. of Trop. Med., 1, no. 4, 215–289, July, 1921.

tient was admitted to the hospital, which was 12 years subsequent to the thorn wound, the diseased tissues were washed out and found to contain granules. These granules when crushed and examined with a microscope and also when sectioned showed the presence of fungous hyphae. Portions of these granules when transferred to culture media produced an abundant growth of an apparently pure culture of the organism under discussion.

The history of the case and the nature of the fungus appear to indicate that this organism was probably introduced into the foot with the thorn, and that it had remained there and was perhaps the chief contributing cause of the pathological condition which developed later. Inoculation experiments conducted by Dr. Boyd with guinea pigs were not successful in producing pathological effects of the mycetoma type, the reactions observed in such cases being only such as would be expected from the introduction of a foreign body into the tissues. As the fungus does not appear to be an anaërobic organism, it is difficult to understand how it could have continued to live and develop for so long a period within the tissues of the foot and ankle before any lesion occurred.

Upon receiving the cultures of the fungus, sub-cultures in poured plates were made to isolate ascospores and conidia and to determine the life history of the organism and the genetic relations of the three forms of fructification found. This was soon done as the fungus develops readily on ordinary culture media, such as cornmeal agar or glycerine agar, and in a few weeks produces all the spore forms, beginning with conidia, which are regularly followed by perithecia. The coremia (fig. 3) are not so uniform and regular in appearance as the other spore forms and sometimes do not develop until after perithecia have appeared. In culture on cornmeal agar, colonies developed from spores are white at first, soon becoming gray and with a radiate, fimbriate margin. As conidia begin to form at the center the color becomes pale greenish-ochraceous and the surface has much the same appearance as a culture of *Cladisporium herbarum*. As the cultures become older the growth becomes darker colored and more or less smoky-brown. In a couple of weeks at ordinary laboratory temperatures an abundance of small, globose, cleistogamous perithecia are produced just

beneath or on the surface of the agar. The fungus evidently is related to the same general group of ascomycetes to which *Eurotium* belongs.

The first conidia are borne on loose-branched, spreading hyphae on lateral as well as terminal, short branches or sporophores, as shown in fig. 1 *a*. The spores are nearly hyaline, non-septate, rather variable in form and size, and are held together in groups or small masses at the apex of the sporophore by their mucous envelope. The perithecia have a thin, membranaceous wall without an ostiole. The manner in which the asci arise has not been determined. The perithecia appear to be filled at first with a granular protoplasm which becomes vacuolate as shown in fig. 2 *a*, and the young asci begin to develop toward the center. No signs

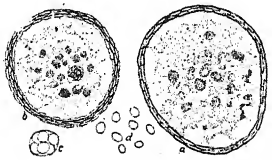


FIG. 2. *Allescheria boydii*. *a*, Median section of a perithecium showing young asci; *b*, submedian section showing a nearly mature ascus with ascospores × 530; *c*, single ascus; *d*, ascospores, × 750.

of hyphae have been observed in the perithecia. The asci become free and the ascus wall disappears as soon as the spores are mature. The coremium form is of the type which has been described by v. Hoehnel as *Dendrostilbella*. The synnema consist of smoky-brown, parallel hyphae which expand at the top to form the coniferous head. The fertile hyphae of the head branch in more or less dendroid sporophores, producing the conidia at the apex of the ultimate branches. These conidia are all so similar in form, size and color that they cannot easily be distinguished from the earlier conidia produced on effuse hyphae.

The fungus is evidently most closely related to the organism described by Costantin in 1896[2] as *Eurotiopsis gayoni*, which was found growing on meal and other organic substances at Paris. As

[2] Costantin, J. Eurotiopsis, Nouveau genre d'Ascomycetes. Bull. Soc. Bot. France, 40: 2d Ser. 15: 236–238, M. 1893.

the name *Eurotiopsis* had already been used for an entirely different fungus, Saccardo substituted the generic name *Allescheria.* The fungus described here differs from Costantin's species in producing coremia, in having larger perithecia, asci, ascospores and conidia and the latter noncatenulate. We regard it as an undescribed species and have named it *Allescheria boydii* in honor of Dr. Boyd, the discoverer.

Its characters are as follows:

Allescheria boydii sp. nov.

I. Perithecia numerous, crowded, covering the surface of the medium, usually erumpent or subsuperficial, globose, thin, membranous, dark-brown astomate, 100–200 μ in diam.; asci globose or subglobose, thin walled, evanescent at maturity, 10–20 μ in diam.; paraphyses none; ascospores 8, globose to subglobose or somewhat ovoid, continuous, smooth, pale yellowish-brown when mature, globose form about 7 μ in diam., other mostly 5.5–7 x 4–4.5 μ.

II. Pycnidia unknown or wanting.

III^a. Byssoid conidial form, *Cephalosporium boydii*, thin, floccose, white at first, soon gray, margin radiate-fimbriate, later changing to pale greenish-ochraceous as sporulation begins, fertile hyphae much branched, spreading, conidiophores lateral or terminal mostly short; conidia adhering in small or large subglobose masses, continuous, subglobose to oblong elliptical, very variable in size and shape, hyaline at first becoming pale, yellowish-brown when old, smooth, 8–15 x 4–7.5 μ, mostly 10–12 x 5–6 μ.

III^b. Coremia (*Dendrostilbella boydii*) with dark brown synnema very variable in height and thickness, 200–300 μ or more high, head subglobose; sporophores alternately branching, ultimate branches once or twice the length of the conidia; conidia practically same size, shape and color as in the byssoid condition and adhering in a globular mass after abstriction.

Isolated from a lesion in a human ankle, by Dr. Mark F. Boyd, Galveston, Tex., 1921. Type: Slides no. 32921*a, Cephalosporium* form; 32921*b, Dendrostilbella* form; 32921*c, Perithecia.*

For greater convenience in referring to the various spore stages of the pleomorphic ascomycetes, we have adopted the Roman numerals used by uredinologists with some modifications to meet the different conditions. I indicates an ascogenous fructification, as a perithecium or apothecium; II indicates a pycnidial fructifica-

tion; and III a conidial stage. Where more than one conidial form occurs in the life cycle of a species, as in the present case, this may be indicated by the use of an alphabetical exponent, as III^a and III^b, and the same may be used where more than one pycnidial form occurs, thus in macro- and micro-pycnidia the former would be II^a and the latter II^b. We have used I for the ascogenous stage, because of the rather uniform, present practice in pleomorphic species of describing this stage first. It should go without saying that no idea of homology with the rusts is to be inferred from the use of similar symbols.

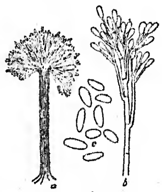


FIG. 3. *Allescheria boydii.* *a,* Dendrostilbella stage, × 277; *b,* conidiophore of same with young conidia, × 530; *c,* conidia of same, × 530.

Binomial names are suggested for the conidial forms of this fungus, because in the present state of our knowledge of the genetic relationships of the various form-genera, it seems necessary to use separate binomials in referring to conidial and pycnidial forms when found separate and there is doubt as to their ascogenous stage. When our knowledge of life cycles is as complete as it is in the rusts, we should be able to discard form-genera and use only the one binomial name and the symbols to indicate the different spore forms.

BUREAU OF PLANT INDUSTRY,
WASHINGTON, D. C.

NOTES ON SOME SPECIES OF COLEOSPORIUM—I

GEORGE G. HEDGCOCK AND N. REX HUNT

(WITH PLATES 20 AND 21)

In a series of two papers it is proposed to give in brief detail hitherto unpublished data including the results of many sets of inoculations with the aecial, uredinial, and telial stages of a number of species of *Coleosporium.* Many negative results are given because of a theory that has been advanced, at least privately by some investigators, that in the eastern United States we probably have only two or three species of *Coleosporium.* That there are species of pine which act as natural bridging hosts which, if infected by a given species of *Coleosporium* from a certain host plant, may bear aecia whose aeciospores are capable of infecting other host plants and producing a second species of *Coleosporium.* This theory would ascribe to a species of pine the power to change the nature of a rust to such an extent that it is able to infect host plants which the urediniospores of the rust may not be able to infect. Negative results have at least some value in proving or disproving a theory, that value being determined largely by the number of cases given, and the care with which the results are obtained. None of the species of pine reported in this paper appear to be bridging hosts, in the light of the results obtained from our experiments.

COLEOSPORIUM HELIANTHI AND COLEOSPORIUM INCONSPICUUM

The forms of *Coleosporium* occurring on species of *Coreopsis, Helianthus, Verbesina* and *Viguiera* in North America were originally assigned by Prof. J. C. Arthur to *Coleosporium helianthi* (Schw.) Arthur in 1907.[1] *Peridermium inconspicuum* Long was discovered and named by Dr. W. H. Long in 1912.[2] The proof

[1] Arthur, J. C. North American Flora, Uredinales, Coleosporiaceae. 7: 93. 1907.

[2] Long, W. H. Two New Species of Rusts. Mycologia 4: 283, 284. 1912.

of the connection of this aecial form with the *Coleosporium* on species of *Coreopsis* in 1913[3] led to the separation of *Coleosporium inconspicuum* (Long) Hedgc. & Long from *Coleosporium helianthi.* The discovery of the aecial form of *Coleosporium helianthi* by the senior writer in 1914, and the publication of the proof of its relation to the *Coleosporium* on species of *Helianthus* in 1917,[4, 5] leaves in the eastern United States the forms of *Coleosporium* on *Verbesina* and *Viguiera* without proven aecial forms.

INOCULATIONS WITH COLEOSPORIUM HELIANTHI

The superficial resemblance of the aecia of *Coleosporium helianthi* (Pl. 20, fig. 2) to those of *Coleosporium inconspicuum* (Pl. 20, fig. 1) has necessitated extensive inoculations with the aeciospores from both forms, the results of which will now be given.[6] Fortunately several of the earlier collections of the aecia of *Coleosporium helianthi* were from localities either where species of *Coreopsis* were not present, or were not infected with *Coleosporium* if present, and several collections of *Coleosporium inconspicuum* were obtained from localities either where species of *Helianthus* were not present, or if present were not infected. This afforded an opportunity to experiment with reasonably pure natural stocks of each rust. Later these results were verified by the use of aeciospores from pedigreed aecia obtained by inoculating in separate experiments trees of *Pinus virginiana* with the telia of each species of *Coleosporium.*

From 1914 to 1921, twelve sets of inoculations were made with the aeciospores of *Coleosporium helianthi* and from 1915 to 1921, fourteen sets with those of *C. inconspicuum* in the greenhouses at Washington, D. C. As in all our inoculation experiments with aeciospores and urediniospores of species of *Coleosporium,* the

[3] Hedgcock, G. G., & Long, W. H. Notes on Cultures of Three Species of *Peridermium.* Phytopathology 3: 250, 251. August, 1913.

[4] Hedgcock, G. G., & Hunt, N. R. An Alternate Form for *Coleosporium helianthi.* Phytopathology 7: 67, 68. February, 1917.

[5] Hedgcock, G. G., & Hunt, N. R. New Species of *Peridermium.* Mycologia 9: 240, 241. July, 1917.

[6] Dr. Wm. H. Long assisted the senior writer during 1913 and 1914, and Mr. N. Rex Hunt from 1915 to 1918.

spores were either placed or allowed to fall on the moistened surfaces, especially the under one, of the leaves; the plants were then kept in moist chambers or iceless refrigerators[7] 2 to 4 days, then placed in rooms or compartments of the greenhouse separate from plants inoculated with other species of *Coleosporium*. In inoculations with sporidia, whole infected plants or the leaves of infected plants were either suspended over the pine trees or laid on a wire netting over them in a large moist chamber or an iceless refrigerator for 2 to 4 days. The iceless refrigerator is the best form of inoculating chamber that we have used, more especially in warm weather. An equal number of control plants were placed uninoculated under similar conditions, apart from the inoculated sets of plants. Plants grown from healthy cuttings or from seed in the greenhouses were used. In each experiment given in this series of papers the control plants remained healthy.

In the aecial inoculations with *Coleosporium helianthi*, aeciospores from aecia collected[8] on *Pinus virginiana* from the following localities were used separately in the experiments: Greenwood Furnace, Pa.; Washington, D. C.; Chain Bridge, Va.; Black Mountain and Marion, N. C.; Greenville, S. C.; and Rome, Ga. Plants as follows were inoculated: 1 *Aster cordifolius*,[9] 1 *A. laevis*, 1 *A. undulatus*, 9 *Coreopsis major*, 10 *C. verticillata*, 1 *C. tripteris*, 1 *Chrysopsis mariana*, 16 *Helianthus decapetalus*, 6 *H. divaricatus*, 2 *H. dowellianus*, 1 *H. giganteus*, 2 *H. glaucus*, 16 *H. hirsutus*, 3 *H. microcephalus*, 2 *H. radula*, 1 *Laciniaria elegans*, 3 *Parthenium integrifolium*, 1 *Rudbeckia laciniata*, 2 *Silphium asteriscus*, 2 *S. integrifolium*, 1 *S. perfoliatum*, 1 *S. trifoliatum*,

7 Hunt, N. Rex. The "Iceless Refrigerator" as an Inoculation Chamber. Phytopathology 9: 211–212. May, 1919.

8 Unless otherwise credited all collections used in inoculations and noted in this series of papers were made by the senior writer.

9 Unless the authority is designated, the names used for species of plants from the southeastern United States are those used by Small, J. H., Flora of the Southeastern United States, 1913. For those from the northeastern United States, Britton, N. L., & Brown, A., Illustrated Flora of the Northeastern United States, etc., 1898. For those from the Rocky Mountain region, Rydberg, P. A., Flora of Colorado. For those from the northwestern United States, Piper, C. V., Flora of Washington, Contributions from the National Herbarium, Vol. XI, 1906.

1 *Solidago canadensis,* 2 *Verbesina virginica* and 1 *Vernonia noveboracensis.* Of these plants, only those of species of *Helianthus* became infected, bearing mature uredinia in 12 to 15 days and mature telia in 6 weeks to 2 months. The number of plants infected of each species was as follows: 5 *H. decapetalus,* 3 *H. divaricatus,* 1 *H. giganteus,* 2 *H. glaucus,* 13 *H. hirsutus,* 1 *H. microcephalus* and 2 *H. radula.* On the last-named species the rust is now reported for the first time. Of the 20 plants of species of *Coreopsis* inoculated, none were infected.

Inoculations were made with the urediniospores of *Coleosporium helianthi* from *Helianthus hirsutus* obtained from previous inoculations June 10, 1919, on the following plants: 2 *H. hirsutus,* 2 *H. radula,* 2 *Coreopsis major* and 4 *C. verticillata.* All the plants of *Helianthus* became infected, bearing mature uredinia June 26 and telia July 20. All plants of *Coreopsis* remained free from infection.

Pine trees were inoculated September 29, 1920, with the sporidia from the telia of *Coleosporium helianthi* on *Helianthus decapetalus* collected the previous day near Chain Bridge, Va. The following trees were inoculated: 1 *P. caribaea,* 1 *P. edulis* Engelm., 1 *P. glabra,* 2 *P. radiata* Don. and 8 *P. virginiana.* Seven trees of the last-named species were infected, many mature pycnia appearing on the needles by March 21, 1921, and abundant mature aecia by April 20. The other trees remained uninfected.

Aeciospores of *Coleosporium helianthi* from the preceding experiment were inoculated April 20, 1921, on the following plants: 1 *Coreopsis major,* 2 *C. verticillata,* 1 *Helianthus divaricatus* and 2 *H. hirsutus.* Only the three plants of *Helianthus* were infected with the *Coleosporium,* producing both the uredinial and telial stages.

INOCULATIONS WITH COLEOSPORIUM INCONSPICUUM

In the aecial inoculations with *Coleosporium inconspicuum,* aeciospores from aecia collected on *Pinus virginiana* from the following localities were used separately in the experiments: Takoma Park, Md.; Washington, D. C.; Roanoke, Va.; Asheville, Black Mountain and Hot Springs, N. C. Plants as follows were inocu-

lated: 1 *Chrysopsis mariana,* 1 *Coreopsis lanceolata,* 16 *C. major,* 1 *C. tripteris,* 26 *C. verticillata,* 1 *Elephantopus carolinianus,* 10 *Helianthus decapetalus,* 1 *H. divaricatus,* 2 *H. dowellianus,* 1 *H. glaucus,* 10 *H. hirsutus,* 4 *H. microcephalus,* 1 *H. occidentalis,* 1 *H. tuberosus,* 1 *Laciniaria elegans,* 2 *Silphium integrifolium,* 4 *Verbesina virginica,* 2 *Vernonia blodgettii,* 3 *V. flaccidifolia,* 1 *V. glauca,* 2 *V. oligantha* and 2 *V. noveboracensis.* Of these plants, only those of species of *Coreopsis* became infected, many of them abundantly, bearing mature uredinia in 13 to 16 days, and mature telia in about 2 months. The number of plants of each species infected was as follows: 1 *C. lanceolata,* 7 *C. major,* 20 *C. verticillata* and 1 *C. tripteris.*

Aeciospores of *Coleosporium inconspicuum* from aecia on *Pinus echinata* collected near Mt. Airy, N. C., were used March 22, 1919, to inoculate plants as follows: 2 *Coreopsis major,* 1 *C. verticillata* and 1 *Helianthus hirsutus,* and on the same date a duplicate set of plants was inoculated with aeciospores from a collection of aecia on *Pinus palustris* made near Styx, S. C., May 11. In each of these two experiments, only the plants of *C. verticillata* became infected with the *Coleosporium,* proving it to be *C. inconspicuum* in each case.

Pine trees were inoculated September 29, 1920, with the sporidia from the telia of *Coleosporium inconspicuum* on *Coreopsis verticillata,* collected the preceding day in Virginia, near Washington, D. C. The following trees were inoculated: 1 *Pinus glabra,* 4 *P. virginiana.* All the trees of the latter species were infected, bearing mature pycnia on the needles by March 2, 1921, and mature aecia by April 20.

Aeciospores of *Coleosporium inconspicuum* from the preceding experiment were inoculated April 20, 1921, on the following plants: 1 *Coreopsis major,* 6 *C. verticillata* and 2 *Helianthus hirsutus.* The one plant of *C. major* and 4 of *C. verticillata* were infected with the *Coleosporium,* producing both the uredinial and telial stages.

All our inoculations fail to furnish the slightest proof that *Coleosporium helianthi* and *C. inconspicuum* are identical physiologically, but on the contrary indicate that they are distinct species.

The aecial forms of the two species do not differ widely in morphology, as is shown by the following table:

TABLE OF COMPARISON

Coleosporium helianthi	*Coleosporium inconspicuum*
Pycnia solitary or few, clustered, deep chrome[10] to raw umber. When fresh, 0.38 mm. wide by 0.5 mm. long.[11]	*Pycnia* few to many, in extended rows, yellow ochre to Dresden brown when fresh, 0.28 mm. wide by 0.64 mm. long.
Aecia solitary or few, aggregated, linguaform to flattened rhomboidal. 0.9 mm. high by 1 mm. long (plate 20, fig. 2).	*Aecia* few to many, aggregated or in short rows, tubular to linguaform, 0.9 mm. high by 0.6 mm. long (plate 20, fig. 1).
Peridial cells 17 by 36 μ, walls 5 μ thick.	*Peridial cells* 20 by 38 μ, walls 4 μ thick.
Aeciospores 16 by 27 μ, walls 2.6 μ thick.	*Aeciospores* 15 by 25 μ, walls 2.4 μ thick.

The pycnia of *Coleosporium inconspicuum* are slightly darker in color, and the aecia are more nearly tubular (Plate 20, fig. 1) than those of *Coleosporium helianthi,* which are more commonly flattened (Plate 20, fig. 2).

THE COLEOSPORIUM ON VERBESINA

The *Coleosporium* occurring on *Verbesina* has been assigned by Prof. Arthur to *Coleosporium helianthi.* In the experiments already mentioned with aeciospores of both *C. helianthi* and *C. inconspicuum* all plants of *Verbesina* failed of infection. The following inoculations were made with the *Coleosporium* from *Verbesina* obtained in Florida:

March 12, 1914, urediniospores from a collection made by Dr. Long at New Smyrna, March 9, were used to inoculate the following plants without infection: 1 *Elephantopus carolinianus,* 2 *E. tomentosus,* 1 *Solidago bicolor,* 2 *S. juncea* and 1 *Vernonia glauca.*

March 11, 1915, urediniospores from a collection by the senior writer in the same locality, March 4, were used to inoculate successfully 3 plants of *Verbesina virginica,* which bore uredinia

[10] Colors used are those of Ridgway, R. Color standards and nomenclature. Washington, D. C. 1912.

[11] Measurements are based on an average of 60, 10 each for six different collections.

March 30 and telia May 25. April 28, 18 plants of *Verbesina* were successfully inoculated with urediniospores from the previous culture, bearing mature uredinia in 14 to 18 days and telia in about 2 months.

In 1919, urediniospores were again obtained from a collection by Dr. Long at East Palm Beach, and the following plants were inoculated: 2 *Coreopsis verticillata,* 4 *C. major,* 2 *Elephantopus carolinianus,* 4 *H. decapetalus,* 6 *H. hirsutus,* 3 *H. radula,* 2 *Silphium asteriscum,* 2 *S. integrifolium,* 13 *Verbesina virginica* and 2 *Vernonia flaccidifolia.* Only the plants of *Verbesina* were infected, bearing mature uredinia in 14 to 17 days and telia in about 2 months.

Since the urediniospores of this *Coleosporium* from *Verbesina* do not infect plants of species of *Coreopsis, Elephantopus, Helianthus, Silphium, Solidago* and *Vernonia,* it appears it does not belong to any of the species of *Coleosporium* attacking these plants, viz., *C. inconspicuum, C. helianthi, C. terebinthinaceae, C. solidaginis* and *C. carneum,* and it is predicted that it has a distinct aecial form not yet collected or known.

DISTRIBUTION OF THE SPECIES

Coleosporium helianthi, according to our records, has been collected in the United States as follows:

O and I on *Pinus:*

P banksiana: Michigan.

P. echinata: Georgia.

P. virginiana: Maryland, Pennsylvania, North Carolina, South Carolina, Tennessee, Virginia and West Virginia.

II and III on *Helianthus:*

H. australis: North Carolina.

H. decapetalus: Indiana, Maryland, New York, North Carolina, South Carolina, Pennsylvania, Tennessee and Virginia.

H. divaricatus: District of Columbia, Georgia, North Carolina, Pennsylvania, Tennessee and Virginia.

H. doroconoides: Ohio and Minnesota.

H. eggertii: Tennessee.

H. giganteus: Alabama, Mississippi, New York, Pennsylvania and West Virginia.

H. glaucus: Georgia and Tennessee.

H. grosseserratus: North Carolina and West Virginia.

H. microcephalus: Alabama, Georgia, North Carolina, South Carolina, Tennessee and Virginia.

H. occidentalis: Louisiana.

H. saxicola Small: Georgia.

H. strumosus: Alabama.

H. tuberosus: Alabama, South Carolina and Virginia.

Coleosporium helianthi has been successfully inoculated upon the following species: *Pinus virginiana, Helianthus decapetalus, H. divaricatus, H. glaucus, H. microcephalus* and *H. radula.*

Coleosporium inconspicuum, according to our records, has been collected in the United States as follows:

O and I on *Pinus:*

P. echinata: Georgia and North Carolina.

P. palustris: South Carolina.

P. virginiana: District of Columbia, Georgia, Maryland, North Carolina and Virginia.

II and III on *Coreopsis:*

C. delphinifolia: Tennessee.

C. lanceolata: North Carolina and Tennessee.

C. major: Georgia, North Carolina, South Carolina and Tennessee.

C. major oemleri: Georgia, North Carolina, Tennessee and Virginia.

C. major rigida: Georgia, North Carolina and Tennessee.

C. tripteris: Georgia and Tennessee.

C. verticillata: District of Columbia, Maryland, North Carolina and Virginia.

Coleosporium inconspicuum has been successfully inoculated upon the following species: *Pinus virginiana, Coreopsis lanceolata, C. major, C. verticillata* and *C. tripteris.*

From the foregoing data, it will readily be seen that *Coleosporium helianthi* has a much wider known distribution in the United States than *Coleosporium inconspicuum,* as it ranges from Minnesota and New York on the north to Louisiana and Georgia on the south, as compared with a range for *C. inconspicuum* from Maryland and Michigan south to Georgia and west to Tennessee.

COLEOSPORIUM TEREBINTHINACEAE

Coleosporium terebinthinaceae (Schw.) Arthur was first described in the uredinial stage as *Uredo terebinthinaceae* by Schweinitz[12] in 1822. It was transferred to the genus *Coleosporium* by Professor Arthur[13] in 1907. The aecial form was discovered by the senior writer in 1916, and described in 1917.[14]

[12] Schweinitz, L. D. Synopsis Fungorum Carolinae Superoris. Schrift. Naturf. Ges. Leipzig 1: 70. 1822.

[13] Arthur, J. C. North American Flora, Uredinales, *Coleosporium.* 7: 93. 1907.

[14] Hedgcock, Geo. G., & Hunt, N. Rex. New Species of *Peridermium.* Mycologia 9: 240. 1917.

In the study of *Coleosporium terebinthinaceae* the following inoculations have been made:

During May, 1916, and April, 1918, 7 sets of separate inoculations were made with aeciospores from collections made on *Pinus echinata* at Auburn, Ala.; Gainesville, Ga.; Clearwater, S. C.; and Marion, N. C. Plants of the following species were inoculated: 3 *Amsonia ciliata,* 2 *Coreopsis verticillata,* 2 *Laciniaria graminifolia,* 10 *Parthenium integrifolium,* 1 *Silphium asteriscus,* 13 *S. integrifolium* and 3 *S. trifoliatum.* The following plants were infected, some of them heavily, bearing mature uredinia in 11 to 13 days and telia in about 2 months: 1 *Silphium asteriscus,* 4 *S. integrifolium,* 3 *S. trifoliatum* and 1 *Parthenium integrifolium.*

Urediniospores obtained from *Silphium integrifolium* in one of the preceding inoculations were used June 27, 1916, to inoculate plants as follows: 2 *Silphium integrifolium,* 1 *S. trifoliatum* and 2 *Parthenium integrifolium.* One plant each of *S. integrifolium* and *S. trifoliatum* were infected heavily, bearing mature uredinia in 13 days and mature telia in about 2 months.

A number of inoculations were made with telia on several species of pine during 1915 and 1916 without infection.

Although plants of but few species have been tested by inoculation with the aeciospores of *C. terebinthinaceae,* a large number of plants of species of *Silphium* and *Parthenium* susceptible to this species of *Coleosporium* have been tested, without infection, by inoculation with the aeciospores of the following species of *Coleosporium: C. carneum* (Bosc.) Jackson, *C. elephantopodis* (Schw.) Thüm., *C. helianthi* (Schw.) Arthur, *C. inconspicuum* (Long) Hedgc. & Long, *C. ipomoeae* (Schw.) Burrill, *C. minutum* Hedgc. & Hunt, and *C. solidaginis* (Schw.) Thüm.

Coleosporium terebinthinaceae according to our records has been collected in the United States as follows:

O and I on *Pinus:*

P. echinata: Alabama, Georgia, North Carolina and South Carolina.

P. palustris: South Carolina.

P. rigida: North Carolina.

P. serotina: South Carolina.

P. taeda: Alabama and South Carolina.

II and III on *Parthenium* and *Silphium:*

P. integrifolium: Alabama, Georgia, North Carolina, Tennessee and Virginia.

S. angustatum: Alabama, Georgia and South Carolina.

S. asperrimum: Texas.

S. asteriscus: Georgia, Louisiana, North Carolina and South Carolina.

S. compositum: Alabama, Georgia, North Carolina, Tennessee and Virginia.

S. dentatum: Georgia, North Carolina and South Carolina.

S. glabrum Eggert: Georgia and Tennessee.

S. gracile: Texas.

S. integrifolium: Alabama, Arkansas, Georgia, Illinois, Indiana, Louisiana, Mississippi and Missouri.

S. laciniatum: Iowa and Kansas.

S. laevigatum: Alabama.

S. pinnatifidum: Georgia.

S. scaberrimum: Texas.

S. terebinthinaceum: Illinois, Indiana and North Carolina.

S. trifoliatum: Alabama, North Carolina and Virginia.

Coleosporium terebinthinaceae has been successfully inoculated upon *Parthenium integrifolium, Silphium asteriscus, S. integrifolium,* and *S. trifoliatum.*

The aecial stage of this *Coleosporium* is a small species, resembling somewhat *C. laciniariae* Arthur, *C. helianthi*[15] and *C. inconspicuum.*

A comparison of the morphology of *Coleosporium terebinthinaceae* with that of *C. laciniariae* follows:

TABLE OF COMPARISON

Coleosporium terebinthinaceae	*Coleosporium laciniariae.*
Pycnia solitary or few, usually in short rows, orange-rufous to mummy-brown when fresh, on olive-yellow spots, 0.2 mm. wide by 0.4 mm. long.	*Pycnia* solitary or few, usually aggregated, salmon-orange to olivaceous-black when fresh, on light-green spots, 0.4 mm. wide by 0.6 mm. long.
Aecia solitary to few, usually in short rows, linguaform to flattened rhomboidal, 1.4 mm. high by 1.1 mm. long.	*Aecia* solitary to few, usually aggregated, flattened rhomboidal, 0.4 mm. high by 1.5 mm. long.
Aeciospores 20 by 30 μ with walls 3 μ thick.	*Aeciospores* 20 by 31 μ with walls 2 μ thick.
Peridial cells 26 by 53 μ with walls 4 μ thick.	*Peridial cells* 25 by 40 μ with walls 5 μ thick.

The pycnia of *Coleosporium terebinthinaceae* are brown and those of *C. laciniariae* are black at the time when the aecia are beginning to appear. It is possible at this stage to determine most

[15] For a comparison with the aecial stages of *C. helianthi* and *C. inconspicuum,* see the "Table of Comparison" on another page of this article.

of the species of *Coleosporium* in the eastern United States from pycnial characters, where freshly collected specimens are available.

COLEOSPORIUM DELICATULUM

Coleosporium delicatulum (Arthur & Kern) Hedgc. & Long was first described in the aecial stage by Arthur and Kern[16] in 1906 as *Peridermium delicatulum*. Proof of the connection of the aecial stage on *Pinus rigida* with the uredinial stage on *Euthamia graminifolia* was obtained by Dr. Long and the senior writer[17] and published in 1913.

Inoculations with *Coleosporium delicatulum* have since been made as follows: During April and May, 1913, nine sets of inoculations were made with aeciospores from collections of aecia made on *Pinus rigida* near Takoma Park, D. C. The following plants were inoculated: 1 *Aster conspicuus,* 2 *A. cordifolius,* 3 *A. ericoides,* 1 *A. hesperius,* 1 *A. laevis geyeri,* 3 *A. lenta,* 1 *A. paniculatus,* 3 *A. undulatus,* 14 *Euthamia graminifolia,* 2 *Helianthus divaricatus,* 1 *Ribes nigrum,* 4 *Senecio aureus,* 4 *Solidago bicolor,* 2 *S. canadensis,* 2 *S. erecta,* 5 *S. juncea,* 2 *S. multiradiata* Ait., 3 *S. rugosa* and 1 *S. speciosa.* Of these plants only those of *Euthamia graminifolia* were infected, having mature uredinia in 14 to 16 days and telia in about 2 months.

During May and June, 1914, three sets of inoculations were made with aeciospores from the same source as in 1913. Plants of the following species were inoculated: 1 *A. laevis,* 3 *A. laevis geyeri,* 1 *A. undulatus,* 1 *Elephantopus tomentosus,* 18 *Euthamia graminifolia;* 1 *Helianthus occidentalis,* 2 *Solidago canadensis,* 2 *S. multiradiata,* 3 *S. rugosa* and 2 *Vernonia noveboracensis.* Of these plants only those of *Euthamia* were infected and bore uredinia and telia as in the preceding experiments.

Aeciospores from aecia collected on *Pinus palustris* by Dr. Long at Brooksville, Fla., March 27, were used April 3, 1914, to inoculate plants of the following species: 3 *Euthamia graminifolia,* 1 *Eupatorium maculatum* and 1 *Solidago rugosa.* The plants of *Euthamia* were infected and bore uredinia and telia as before.

16 Arthur, J. C., & Kern, F. D. North American Species of *Peridermium.* Bul. Torrey Bot. Club 33: 404. 1906.

17 Hedgcock, Geo. G., & Long, W. H. Notes on Cultures of Three Species of *Peridermium.* Phytopathology 3: 250. 1913.

April 3, 1914, aeciospores from aecia collected on *Pinus serotina* by Dr. Long at St. Augustine, Fla., March 30, were used to inoculate plants of the following species: 2 *Euthamia graminifolia* and 2 *Solidago rugosa*. Only the plants of *Euthamia* were infected and bore uredinia and telia as before.

During March and April, 1914, aeciospores from aecia collected on *Pinus taeda* by Dr. Long at Brooksville and St. Augustine, Fla., and Henry, S. C., were used to inoculate plants of the following species: 9 *Euthamia graminifolia*, 1 *Helianthus annuus*, 1 *Solidago rugosa* and 3 *S. speciosa*. Only the plants of *Euthamia* became infected and bore uredinia and telia as before.

During April, 1915, aeciospores from aecia collected on *Pinus echinata* at Florence, S. C., were used to inoculate and infect 1 plant of *Euthamia caroliniana* and 2 of *E. graminifolia*, which as a result bore uredinia and telia. Also aeciospores from aecia collected on *Pinus caribaea* at Jacksonville, Fla., were used to infect 3 plants of *Euthamia graminifolia* which bore uredinia and telia as before.

During June, 1916, aeciospores from aecia on *Pinus resinosa* collected by Dr. P. Spaulding at Sharon, Vt., were used to infect *Euthamia graminifolia*, which as a result bore uredinia and telia. Plants of *Euthamia* infected during 1914, 1915, and 1916, bore mature uredinia in 11 to 18 days and mature telia in 5 to 8 weeks.

Inoculations with the sporidia from the telia of *Coleosporium delicatulum* have been made on pine trees as follows:

September 11, 1916, the following were inoculated with sporidia from telia collected September 10 near Takoma Park, D. C.: 1 *Pinus caribaea*,[18] 2 *P. clausa*, 1 *P. contorta*, 1 *P. coulteri*, 1 *P. densiflora* Thunb., 2 *P. echinata*, 2 *P. edulis*, 3 *P. glabra*, 2 *P. mayriana* Sudw., 1 *P. monophylla*, 1 *P. montana* Mill., 1 *P. palustris*, 2 *P. rigida*, 1 *P. scopulorum*, 2 *P. serotina*, 2 *P. taeda* and 1 *P. thunbergii* Parl. Of these trees the following were infected, bearing mature pycnia in January and mature aecia in March, 1917: 1 *P. contorta*, 2 *P. echinata*, 2 *P. glabra*, 1 *P. mayriana*, 1 *P. palustris*, 2 *P. rigida*, 2 *P. serotina* and 1 *P. taeda*.

[18] In these two papers, *P. heterophylla* is considered synonymous with *P. caribaea*, and *P. murrayana* with *P. contorta*.

October 13, 1920, sporidia from telia on *Euthamia graminifolia*, collected the same day near Chain Bridge, D. C., were used to inoculate trees of the following species in pots sunk in beds outside of the greenhouses: 1 *Pinus canariensis* C. Smith, 3 *P. caribaea*, 7 *P. contorta*, 3 *P. coulteri*, 2 *P. echinata*, 1 *P. edulis*, 1 *P. glabra*, 1 *P. mayriana* and 2 *P. scopulorum*. Of these the following were infected, bearing mature pycnia in March and mature aecia late in April, 1921: 1 *P. caribaea*, 1 *P. coulteri* and 2 *P. scopulorum*.

The pycnial stage of *Coleosporium delicatulum* resembles closely that of *C. solidaginis* but the pycnial areas of the former are much brighter colored. The aecia differ quite widely in appearance. The difference in gross morphology between *C. delicatulum* and *C. solidaginis* is shown by the following table:

TABLE OF COMPARISON

Coleosporium delicatulum	*Coleosporium solidaginis*
Pycnia solitary or few, in one or two more or less extended rows, orange-chrome to English-red when fresh, on conspicuous, brightly-reddened spots.	*Pycnia* solitary or few, aggregated in one or two short rows, grenadine-red to mahogany-red when fresh, on inconspicuous, slightly-reddened spots.
Aecia inconspicuous, solitary or few, in one or two more or less extended rows.	*Aecia* conspicuous, solitary or few, aggregated in one to three short rows.
Peridia rupturing on the sides with recurved lacerate edges.	*Peridia* rupturing at the apex with irregular edges.

Coleosporium delicatulum, according to our records, has been collected in the United States as follows:

O and I on *Pinus:*

P. caribaea: Florida and Louisiana.

P. echinata: Maryland, Pennsylvania and South Carolina.

P. mayriana: District of Columbia.

P. nigra poiretiana Schneid: Pennsylvania.

P. palustris: Florida, Georgia, Mississippi and South Carolina.

P. resinosa: Vermont.

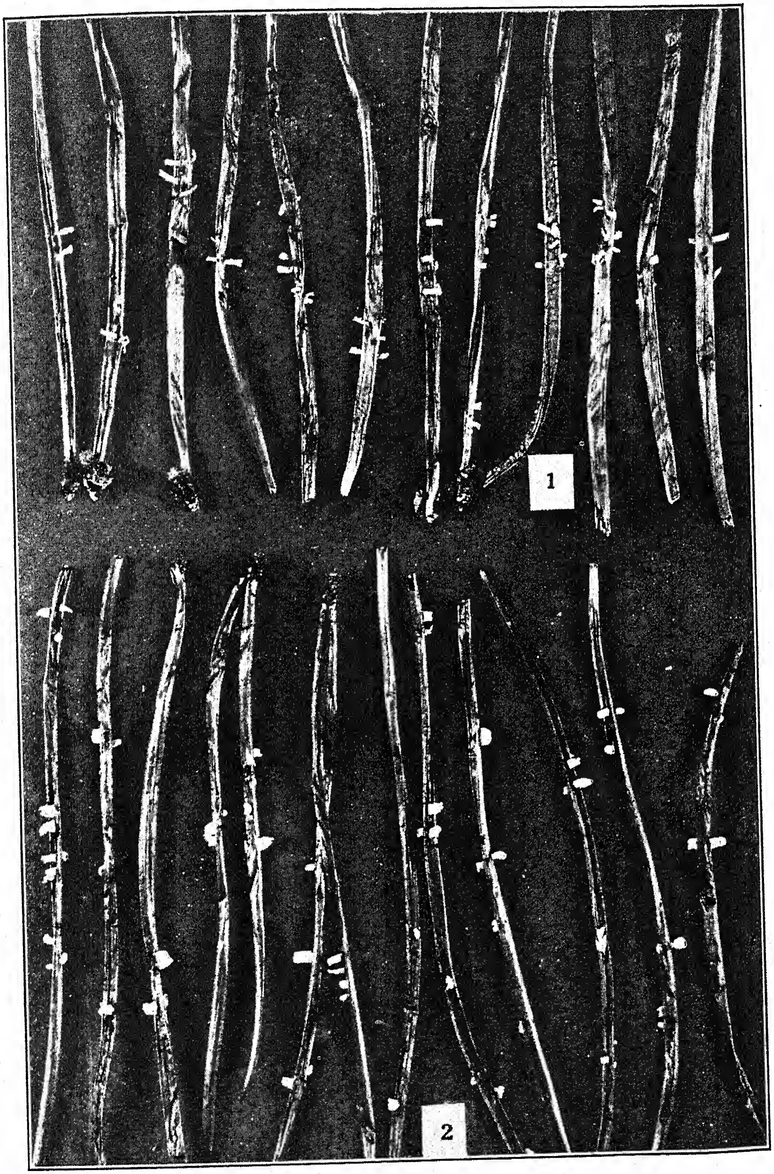
P. rigida: Connecticut, District of Columbia, Maryland, Massachusetts, New Jersey, New York, North Carolina and Pennsylvania.

P. serotina: Florida, Georgia, New Jersey and South Carolina.

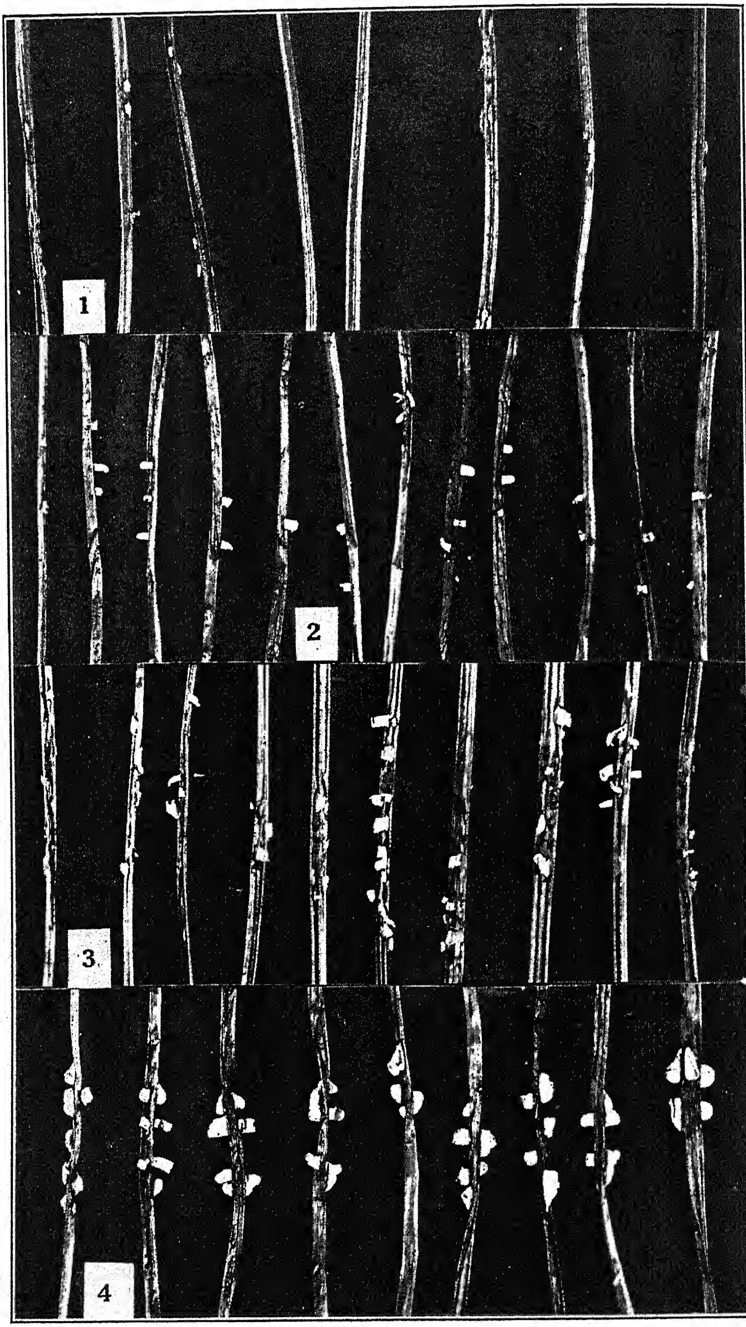
P. taeda: Florida, North Carolina, South Carolina, Virginia and Texas.

II and III on *Euthamia:*

E. caroliniana: Florida and New Jersey.



SPECIES OF COLEOSPORIUM



SPECIES OF COLEOSPORIUM

E. graminifolia: Connecticut, Delaware, District of Columbia, Illinois, Indiana, Kansas, Maryland, Massachusetts, Maine, Missouri, New Hampshire, New Jersey, North Carolina, New York, Pennsylvania, Rhode Island, Virginia and Vermont.

E. leptophylla: Louisiana and Texas.

Coleosporium delicatulum has been successfully inoculated on the following species: *Pinus caribaea, P. contorta, P. coulteri, P. echinata, P. glabra, P. mayriana, P. palustris, P. rigida, P. scopulorum, P. serotina, P. taeda, Euthamia caroliniana* and *E. graminifolia.*

BUREAU OF PLANT INDUSTRY,
WASHINGTON, D. C.

EXPLANATION OF PLATES

PLATE 20

Fig. 1. The aecia of *Coleosporium inconspicuum* on the needles of *Pinus virginiana.* (× 2.)

Fig. 2. The aecia of *Coleosporium helianthi* on the needles of *Pinus virginiana.* (× 2.)

PLATE 21

Fig. 1. The aecia of *Coleosporium delicatulum* on the needles of *Pinus resinosa.* (× 2.)

Fig. 2. The aecia of *Coleosporium terebinthinaceae* on the needles of *Pinus echinata.* (× 2.)

Fig. 3. The aecia of *Coleosporium laciniariae* on the needles of *Pinus palustris.* (× 2.)

Fig. 4. The aecia of *Coleosporium solidaginis* on the needles of *Pinus echinata.* (× 2.)

DARK-SPORED AGARICS—IV

DECONICA, ATYLOSPORA, AND PSATHYRELLA

William A. Murrill

In previous articles of this series, the large, fleshy-stemmed species have been discussed. The present article deals with species having a slender, tubular stipe with cartilaginous cortex, and not furnished with an annulus. The three genera here treated may be distinguished as follows:

Lamellae decurrent.	*Deconica.*
Lamellae adnate or adnexed.	
Spores purplish-brown or dark-fuscous.	*Atylospora.*
Spores black.	*Psathyrella.*

Deconica (W. G. Sm.) Sacc. Syll. Fung. 5: 1058. 1887

Delitescor Earle, Bull. N. Y. Bot. Gard. 5: 434. 1909.

This is a very small genus, separated from *Psilocybe* as a subgenus by W. G. Smith in 1870, because of its decurrent lamellae, and raised to generic rank by Saccardo in 1887. The attachment of the lamellae often varies to adnate or to adnate with a decurrent tooth. Two species, *D. bullacea* and *D. scatigena,* were discussed in my article on tropical agarics published in *Mycologia* for January, 1918.

Stipe 5–8 cm. long.	1. *D. coprophila.*
Stipe 1–5 cm. long.	
Pileus floccose or tomentose, not striate.	
Pileus floccose near and on the margin.	2. *D. rhomboidospora.*
Pileus tomentose over the entire surface.	3. *D. tomentosa.*
Pileus glabrous, usually striate.	
Pileus dry or hygrophanous, not viscid.	
Stipe 1–2.5 cm. long.	
Pileus not umbonate.	4. *D. bulbosa.*
Pileus umbonate.	5. *D. semistriata.*
Stipe 2.5–5 cm. long.	
Pileus not decidedly umbonate.	6. *D. polytrichophila.*
Pileus decidedly umbonate.	7. *D. pyrispora.*
Pileus viscid.	
Spores $7 \times 5\ \mu$.	8. *D. subviscida.*
Spores $12 \times 9\ \mu$.	9. *D. bullacea.*

1. DECONICA COPROPHILA (Bull.) Sacc. Syll. Fung. 5: 1058. 1887

Agaricus coprophilus Bull. Herb. Fr. *pl. 566, f. 3;* hyponym. 1791; Pers. Syn. Fung. 412. 1801.

Pileus hemispheric to expanded, umbonate, 2–4 cm. broad; surface smooth, fulvous-isabelline; lamellae arcuate-subdecurrent, broad, livid-blackish; spores 13–14 x 8 μ; stipe attenuate upward, smooth, pallid, pruinose to glabrous above, glabrous and shining below, subfistulose, 5–8 cm. long, 2–3 mm. thick.

TYPE LOCALITY: France.

HABITAT: On manure or manured ground.

DISTRIBUTION: New York and Michigan; also in Europe.

ILLUSTRATIONS: Bull. Herb. Fr. *pl. 566, f. 3;* Cooke, Brit. Fungi. *pl. 608A* (*608A*).

There are several specimens bearing this name at Albany collected by Peck in New York, and also one collection sent by Kauffman from Michigan. The spores of Peck's plants are elongate-ellipsoid, smooth, isabelline under the microscope, about 12 x 6–7 μ.

2. DECONICA RHOMBOIDOSPORA Atk. Ann. Myc. 7: 368. 1909

Pileus ovoid to convex, gregarious to subcespitose, 0.5–1 cm. broad; surface dry, smooth, not striate, ochraceous to clay-colored, adorned on and near the margin with whitish flocci; context ochraceous, with slightly mealy taste and no characteristic odor; lamellae adnate and decurrent, about 2 mm. broad, becoming chestnut-colored with whitish, dentate edges; spores ovoid to subrhomboid, smooth, purplish-brown, 5–7 x 4–5 μ; stipe flexuous, hollow, chestnut-colored within, clay-colored and whitish-fibrillose without, 2–3 cm. long, 2 mm. thick; veil evident when young, white, soon appendiculate.

TYPE LOCALITY: Ithaca, New York.

HABITAT: On leaves and decayed wood on the ground.

DISTRIBUTION: Known only from the type locality.

The type specimens, which I have not seen, were found by Jackson on June 5, 1904. According to Atkinson, it is near *D. nuciseda* Fries.

3. **Deconica tomentosa** sp. nov.

Pileus convex to nearly plane, not umbonate, solitary, about 1.5 cm. broad; surface dry, not at all striate, uniformly ochraceous-

ferruginous, clothed with a tufted, yellowish-brown tomentum that has a tendency to crack in areoles, reminding one of some species of *Inocybe,* margin incurved, entire, slightly paler; lamellae distinctly decurrent, distant, narrow, nearly white, becoming pale-purplish-brown, entire and scarcely paler on the edges, beautifully undulate in dried specimens; spores ellipsoid, rounded at both ends, smooth, pale-smoky-isabelline under the microscope, pale-purplish-brown in mass, 7–9 x 4–6 μ; stipe short, tapering downward, yellowish-white, clothed above with whitish tomentum and fibrils, about 1.5 cm. long, and 2 mm. thick.

TYPE LOCALITY: Auburn, Alabama.

HABITAT: On the ground.

DISTRIBUTION: Known only from the type locality.

Type collected by F. S. Earle on November 11, 1899.

4. DECONICA BULBOSA Peck, Ann. Rep. N. Y. State Mus. **46**: 107. 1893

Pileus submembranaceous, convex becoming nearly plane, 6–12 mm. broad; surface glabrous, slightly striate on the margin, whitish tinged with brown; lamellae broad, distant, adnate, purplish-brown; spores ellipsoid, purplish-brown, 7.5 x 5 μ; stipe slender, firm, hollow, bulbous, densely grayish-fibrillose, 1.5–2.5 cm. long, scarcely 1 mm. thick.

TYPE LOCALITY: Delmar, New York.

HABITAT: On dead stems of herbs.

DISTRIBUTION: Known only from the type locality.

The small type specimens are at Albany, collected by Peck in September.

5. DECONICA SEMISTRIATA Peck, Ann. Rep. N. Y. State Mus. **51**: 291. 1898

Pileus thin except on the prominent broadly-umbonate disk, 8–10 mm. broad; surface glabrous, somewhat wavy on the margin and striate to the umbo, grayish-brown, paler when dry and less distinctly striate, the broad umbo yellowish; lamellae broad, distant or subdistant, adnate or slightly decurrent, purplish-brown, whitish on the edges; spores compressed, suborbicular, 6.5–7.5 x 6.5 μ; stipe equal, firm, short, slightly floccose-fibrillose, stuffed with a whitish pith, colored like the pileus, 16–20 mm. long, 1 mm. thick.

TYPE LOCALITY: Gansevoort, New York.

HABITAT: On damp ground in woods.

DISTRIBUTION: Known only from the type locality.

Known only from two little plants collected by Peck in July and now attached to a sheet at Albany.

6. **Deconica polytrichophila** (Peck) comb. nov.

Agaricus polytrichophilus Peck, Ann. Rep. N. Y. State Mus. 30: 42. 1878.

Psathyra polytrichophila Sacc. Syll. Fung. 5: 1068. 1887.

Deconica bryophila Peck, Ann. Rep. N. Y. State Mus. 46: 106. 1893.

Pileus thin, convex or subcampanulate, gregarious, 4–10 mm. broad; surface glabrous, sometimes with a slight umbo, hygrophanous, striatulate and brown when moist, dull-ochraceous or buff when dry, somewhat shining; context rather fragile, odorous; lamellae plane and adnate or slightly arcuate and decurrent, broad, subdistant, colored almost like the pileus; spores subellipsoid, purplish-brown, 8 x 5 μ; stipe slender, equal, subflexuous, slightly whitish-fibrillose, especially toward the base, mealy at the apex, concolorous, containing a whitish pith, 2.5–5 cm. long.

TYPE LOCALITY: West Albany, New York.

HABITAT: On the ground among *Polytrichum* or other mosses.

DISTRIBUTION: New York and Massachusetts.

Peck found this species twice in May. The type specimens are at Albany. I got specimens at Lake Placid (*156*) in July, 1912, growing on a sandy, mossy bank in woods, and described them as follows:

"Hemispheric, slightly striate-sulcate on the margin, 4–5 mm. broad, smooth. glabrous, isabelline at the center, umbrinous-isabelline otherwise, margin straight; lamellae plane, distant, adnate with a decurrent tooth, pale-ferruginous or about umbrinous; stipe pruinose at the apex, latericious, glabrous, filiform, tough, 3 cm. long, 0.5 mm. thick."

Deconica bryophila was described from specimens collected by Peck in May at Delmar and Karner. There are several collections at Albany from New York, and two from Massachusetts, collected by Mackintosh and Davis in April and June respectively.

7. **Deconica pyrispora** sp. nov.

Pileus convex to subexpanded, abruptly umbonate, solitary, about 1 cm. broad; surface glabrous, dry or slightly hygrophanous, avellaneous, striate to the umbo, which is smooth and isabelline,

margin straight, appressed in young stages; lamellae slightly decurrent, or adnate with a decurrent tooth, inserted, somewhat ventricose, of medium distance, rather uneven on the edges, becoming purplish-brown, not variegated; spores pear-shaped, tapering gradually at one end and abruptly at the other, smooth, pale-smoky-purplish-brown under the microscope, about 7 x 3.5–4.5 μ; stipe curved, equal, decidedly cartilaginous, glabrous, fibrillose toward the base, chestnut-colored, about 3.5 cm. long and 1.5 mm. thick.

Type locality: New York Botanical Garden, New York City.

Habitat: In an old chestnut stump, growing on rotten wood and humus.

Distribution: Known only from the type locality.

This interesting little species was found by me on August 29, 1911. It is characterized by a prominent nipple-like umbo and pear-shaped spores, which are purplish-black in mass. The affinities of the species are with *Atylospora;* but the lamellae are quite decurrent, and this character is seen to good advantage even in dried specimens.

8. Deconica subviscida Peck, Ann. Rep. N. Y. State Mus. 41: 70. 1888

Pileus thin, at first subconic, then convex or nearly plane, often slightly umbonate, gregarious, 6–12 mm. broad; surface glabrous, hygrophanous, pale-chestnut or reddish-tan-colored, subviscid and striatulate on the margin when moist, pallid or dull-buff when dry; lamellae broad, subdistant, adnate or slightly decurrent, at first whitish or dingy, then brownish-ferruginous; spores ellipsoid or ovoid, smooth, pale-ochraceous under the microscope, 7 x 5 μ; stipe equal or tapering downward, fibrillose, hollow, brownish toward the base, paler above, the fibrils whitish or grayish, 2.5 cm. long, 2 mm. thick; veil slight, white, evanescent.

Type locality: Menands, New York.

Habitat: On horse manure and manured ground.

Distribution: New York and Michigan.

Peck collected the type specimens in August. He says it appears in wet weather in great abundance and in successive crops. Kauffman reports it from Michigan, growing in the open on manure and in the woods on moss. Both Peck and Kauffman consider it very nearly related to *D. bullacea,* which is true if the general appear-

ance alone is considered, but the lamellae and spores are totally distinct.

9. DECONICA BULLACEA (Bull.) Sacc. Syll. Fung. 5: 1058. 1887

Agaricus bullaceus Bull. Herb. Fr. *pl. 566, f. 2;* hyponym. 1791; Pers. Syn. Fung. 412. 1801.

Pileus convex-hemispheric, sometimes umbonate, gregarious, 0.5–2 cm. broad; surface glabrous, viscid, smooth, slightly striate at times, bay-brown when fresh and moist, paler with age or on drying; context brownish-pallid, mild; lamellae adnate-decurrent, plane, very broad, triangular, subdistant, dark-purplish-brown at maturity with whitish edges; spores broadly-ellipsoid to ovoid, usually tapering at both ends, apiculate, smooth, varying from ochraceous to dull-ferruginous or darker under the microscope, purplish-brown in mass, 10–12 x 8–9 μ; stipe cylindric, equal, pale-brownish, subfibrillose, solid or stuffed, 3–5 cm. long, 1–2 mm. thick; veil slight, evanescent.

TYPE LOCALITY: France.

HABITAT: Usually on horse manure in pastures and along roads.

DISTRIBUTION: Eastern United States, south to Mississippi, and west to Michigan; also in Europe; abundant in tropical America.

ILLUSTRATIONS: Bull. Herb. Fr. *pl. 566, f. 2;* Cooke, Brit. Fungi *pl. 608 B (600 B)*; Pat. Tab. Fung. *f. 235*.

This species was first figured by Bulliard from specimens collected in France. While probably widely distributed, it has not often been reported from this country. The spores of excellent specimens collected in Jamaica are ovoid, smooth, opaque, umbrinous by transmitted light under the microscope, 11–12 x 6–8 μ. They are darker than spores from specimens found in New York City.

DOUBTFUL SPECIES

Deconica atrorufa (Fries) Sacc. Syll. Fung. 5: 1059. 1887. (*Agaricus atrorufus* Fries, Syst. Myc. 1: 293. 1821.) Dr. Kauffman reports this species (as *Psilocybe*) from more than one locality in Michigan, growing gregariously on the ground in woods. His spore measurements agree with those made by Karsten, being 5–8 x 4–5.5 μ. Fries got his name from Schaeffer, but some think he wrongly interpreted Schaeffer's plant.

ATYLOSPORA Fayod, Ann. Sci. Nat. VII. 9: 376. 1889

Psathyra Quél. Champ. Jura Vosg. 118. 1872; not *Psathyra* Spreng. 1818; not *Psathura* Commers. 1789.

This rather difficult genus, well represented both in temperate and tropical regions, is characterized by a cartilaginous stipe, a straight margin appressed when young, and the absence of a veil. It is difficult to distinguish in the herbarium from *Psilocybe* and *Drosophila*. *Psathyrella* differs in having black spores, but even here it is at times hard to draw the line. The species are mostly overlooked or given scant attention by collectors because generally inconspicuous and rather poorly known. In *Mycologia* for January, 1918, I discussed the 21 tropical American species, 11 of which were there described as new. None of our northern forms appear to grow under tropical conditions.

Stipe 2–4 cm. long.	
Densely cespitose.	1. *A. microsperma.*
Not densely cespitose.	2. *A. vestita.*
Stipe 5–10 cm. long.	
Densely cespitose.	3. *A. multipedata.*
Not densely cespitose.	
Stipe 1 mm. thick.	4. *A. prunuliformis.*
Stipe 2–3 mm. thick.	
Pileus pale-fawn-colored.	5. *A. australis.*
Pileus purplish-brown.	6. *A. umbonata.*
Stipe 3–5 mm. thick.	7. *A. striatula.*

1. **Atylospora microsperma** (Peck) comb. nov.

Psathyra microsperma Peck, Bull. Torrey Club **26**: 68. 1899.

Pileus ovoid or subhemispheric, becoming deeply convex or subcampanulate, obtuse, densely cespitose, 1–2.5 cm. broad; surface even, hygrophanous, brown when moist, paler when dry, slightly floccose when young; context brownish; lamellae thin, crowded, adnate-seceding, white to purplish-brown, whitish on the edges; spores smooth, ellipsoid, purplish-brown, about $7 \times 4\,\mu$; stipe equal, rigid-fragile, hollow, pure-white, fibrillose, 2.5–4 cm. long, 2–3 mm. thick.

TYPE LOCALITY: Ohio.

HABITAT: About old stumps.

DISTRIBUTION: Ohio and Michigan.

The type specimens collected by Lloyd (*3480*) in April are fairly well preserved at Albany. Kauffman says it occurs rarely in Michigan, having been found by him (*365*) growing in turf at Ann Arbor, in October, 1905. Some of his specimens determined by Peck are at Albany. They are thinner and more slender than the types.

2. **Atylospora vestita** (Peck) comb. nov.

Psathyra vestita Peck, Bull. N. Y. State Mus. 105: 28. 1906.

Pileus thin, submembranaceous, ovoid, conic or subcampanulate, obtuse, 8–16 mm. broad; surface at first covered with white, floccose fibrils, usually with a rufescent tint, soon paler or white and silky-fibrillose, sometimes slightly striate on the margin; lamellae thin, narrow, close, adnate, white when young, becoming blackish-brown; spores ellipsoid, purplish-brown, 7.5–10 x 5–6 μ; stipe equal, hollow, flexuous, white, floccose-fibrillose, becoming silky-fibrillose, mealy and often striate at the apex, 2.5–4 cm. long, 2–3 mm. thick.

TYPE LOCALITY: North Elba, New York.

HABITAT: On fallen leaves and grass.

DISTRIBUTION: Known only from the type locality.

Type specimens collected by Peck in September, 1905, are well preserved at Albany, appearing much like a small form of *Drosophila appendiculata*. Kauffman recognized *P. semivestita* as occurring in Michigan and remarks that *P. vestita* is "*very similar*, if not the same, but the spore-sizes are given somewhat smaller."

3. **Atylospora multipedata** (Peck) comb. nov.

Psathyra multipedata Peck, Bull. Torrey Club 32: 80. 1905.

Pileus submembranaceous, conic or hemispheric, densely cespitose, forming tufts of many individuals, 12–16 mm. broad; surface glabrous, hygrophanous, light-bay or tawny when moist, cinereous when the moisture has escaped, the center retaining its moisture longer than the margin; lamellae thin, close, adnate, pallid or gray becoming brown, whitish on the edges; spores brown, ellipsoid, 6–8 x 4–5 μ; stipe slender, equal, hollow, brittle, furfuraceous, becoming smooth or sometimes remaining fibrillose near the base, pure-white, 5–10 cm. long, 2 mm. thick.

TYPE LOCALITY: St. Louis, Missouri.

HABITAT: In grassy ground.

DISTRIBUTION: Vicinity of St. Louis, Missouri.

Excellent type specimens are at Albany, collected at one spot by N. M. Glatfelter (*787*) in September and October, 1900, 1902, and 1903. He made good notes on the fresh specimens and sent them to Peck. I have a fine cluster sent me by Dr. Lewis Sherman (*35*), who collected it at Milwaukee, Wisconsin, in October, 1914.

4. **Atylospora prunuliformis** sp. nov.

Pileus thin, subfleshy, convex, obtuse, gregarious to subcespitose, 1 cm. broad; surface dry, glabrous, rugose, pale-fawn-colored or light-tan-colored, margin concolorous, substriate; context thin, pale-tawny, the taste mild; lamellae adnate, broad, subdistant, subventricose, white; spores ellipsoid, sometimes ovoid, smooth, dark-bay under the microscope, about 12 x 6 μ; stipe cylindric, very slender, glabrous, concolorous, paler and brownish at the apex, hollow, whitish-mycelioid at the base, 5 cm. long, 1 mm. thick.

TYPE LOCALITY: New York Botanical Garden, New York City.

HABITAT: In sandy soil in mixed woods.

DISTRIBUTION: Known only from the type locality.

Type collected by F. S. Earle (*89*) on June 22, 1902. This species much resembles *Prunulus*, both in a fresh and dried condition.

5. **Atylospora australis** sp. nov.

Pileus fragile, expanded, subumbonate, gregarious to cespitose, 1–3 cm. broad; surface glabrous, hygrophanous, slightly striate, pale-fawn-colored, slightly darker on the disk; lamellae adnexed, crowded, rather narrow, concolorous, then brownish; spores ellipsoid, smooth, opaque, purplish-brown under the microscope, about 8–9 x 5 μ; stipe rigid-fragile, cylindric or slightly tapering above, glabrous or somewhat atomaceous, hollow, pure-white, 4–6 cm. long, 2–3 mm. thick; veil slight, soon vanishing, white.

TYPE LOCALITY: City Park, New Orleans, Louisiana.

HABITAT: On rotten wood or humus.

DISTRIBUTION: Vicinity of New Orleans.

Type collected by F. S. Earle (*27*) on September 3, 1908. Said to be common at the time. Also by Earle (*117, 118*) at Chalmitte, New Orleans, September 8, 1908.

6. **Atylospora umbonata** (Peck) comb. nov.

Psathyra umbonata Peck, Ann. Rep. N. Y. State Mus. **50**: 106. 1897.

Pileus submembranaceous, campanulate, umbonate, gregarious to cespitose, 2–5 cm. broad; surface hygrophanous, purplish-brown and striatulate when moist, grayish-white when dry, smooth or slightly rugulose, atomate, the umbo commonly paler; context concolorous; lamellae rather broad, moderately crowded, ventricose, subadnate, brownish-red, becoming purplish-brown and finally almost black, whitish on the edges; spores ellipsoid, smooth, purplish-brown under the microscope, blackish-brown to almost black in mass, 12–15 x 7–8 μ; stipe slender, flexuous, rigid-fragile, equal, hollow, white to pallid, slightly mealy at the apex, 5–10 cm. long, 2–3 mm. thick.

TYPE LOCALITY: Lake Pleasant, New York.

HABITAT: On chip dirt.

DISTRIBUTION: New York, Michigan, Missouri, and Washington.

ILLUSTRATION: Kauffm. Agar. Mich. *pl. 56.*

The type specimens, collected by Peck in July, are well preserved at Albany; and specimens sent to Peck from Missouri by Glatfelter appear to match the types. Kauffman reports it as rather frequent in Michigan and gives interesting notes as well as figures of it. I found it at Seattle, Washington, in the autumn of 1911 (*628*), growing in decaying trash in moist woods. This species is probably too near *Atylospora corrugis.* See doubtful species.

7. **Atylospora striatula** sp. nov.

Pileus thin, fragile, conic-campanulate to expanded, subumbonate, sometimes with a small umbilicus, scattered, 2–4 cm. broad; surface dry, glabrous, conspicuously long-striate, dull-bay to isabelline; context thin, brownish, with mild taste; lamellae adnexed, crowded, plane or ventricose, rather narrow, white or isabelline to purplish-brown; spores ellipsoid, smooth, pale-purplish-brown under the microscope, purplish-brown in mass, about 7 x 4 μ; stipe rigid-fragile, equal, smooth, shining-white, hollow, 5–7 cm. long, 3–5 mm. thick.

TYPE LOCALITY: New York Botanical Garden, New York City.

HABITAT: On humus in shaded places.

DISTRIBUTION: Connecticut and New York.

Type collected by W. A. Murrill, July 3, 1915, on leaf-mold in rhododendron beds. Miss Eaton made a colored sketch at that time. Also collected by F. S. Earle at Redding, Connecticut, July 22, 1902 (*614*); at West Park, New York, August 7 and 8, 1903 (*1776, 1811*); and in the New York Botanical Garden, June 16, 1902 (*108*).

DOUBTFUL AND EXCLUDED SPECIES

Agaricus (*Psathyra*) *pholidotus* Mont. Syll. Crypt. 126. 1856. Collected in grassy ground at Columbus, Ohio, by Sullivant. Described as fugacious with scaly disk, reminding one of some species of *Coprinus,* but the gills are blackish-purple. I have not seen the types.

Atylospora corrugis (Pers.) Fayod, Ann. Sci. Nat. VII. **9**: 376. 1889. Specimens from Bresadola greatly resemble the types of *A. umbonata,* but Peck says his species is much darker, striatulate, and atomate, with a less glabrous and more slender stipe and broader spores; also the umbo is very prominent and becomes white on drying.

Psathyra obtusata Fries, Syst. Myc. **1**: 293. 1821. Reported by Kauffman from Michigan, occurring infrequently on very rotten wood. I have not seen his specimens.

Psathyra persimplex Britz. Bot. Centralb. **77**: 436. 1899. Reported by Kauffman as rare on dead wood in hemlock woods in Michigan. He says it differs from *P. obtusata* in the size of its spores and the characteristic spreading of the margin of the pileus.

Psathyra polytrichophila (Peck) Sacc. See *Deconica.*

Psathyra roseolus (Clements) Sacc. Syll. Fung. **14**: 154. 1899. (*Gymnochilus roseolus* Clements, Bot. Surv. Neb. **4**: 23. 1896.) Collected on the ground on bluffs of the Missouri River, at Bellevue, Nebraska. Pileus hemispheric or convex, 1–2.5 cm. broad, glabrous or nearly so, wrinkled, vinous when wet, incarnate when dry; lamellae slightly remote, purplish-cinnamon-colored; spores ellipsoid, dark-purple, 12–13 x 7–8 μ; stipe tall, fragile, fistulose, shining, glabrous, farinaceous-granular at the apex, 4–8 cm. long, 2 mm. thick. I have not seen the types.

Psathyra semivestita (Berk. & Br.) Sacc. Syll. Fung. 5: 1071. 1887. (*Agaricus semivestitus* Berk. & Br. Ann. Mag. Nat. Hist. III. 7: 376. 1861.) Described from England and reported by Kauffman from Michigan, growing gregariously on horse manure. He says Peck's *P. vestita* is *very similar,* and Peck says his species differs in color and in being wholly clothed when young with white, floccose fibrils.

Psathyra silvatica Peck, Ann. Rep. N. Y. State Mus. 42: 116. 1889. The types from North Elba are attached to a sheet at Albany and marked in Peck's handwriting "equal *Tubaria silvatica* Peck." The species is omitted from Peck's later account of the New York species of *Psathyra.*

PSATHYRELLA (Fries) Quél. Champ. Jura Vosg. 122. 1872

Agaricus § *Psathyrella* Fries, Epicr. Myc. 237. 1838.

Characterized by black spores and a straight, appressed margin when young. It is best known, perhaps, through its interesting little representative, *Psathyrella minutula,* which is widely distributed. In *Mycologia* for January, 1918, the six species known from tropical North America were discussed, five of them being there described as new.

Stipe 1–5 cm. long.
  Pileus white or gray, furfuraceous; hymenophores densely gregarious or cespitose. — 1. *P. minutula.*
  Pileus bluish-white, changing to sepia-brown on drying except at the apex. — 2. *P. leucostigma.*
  Pileus reddish-cinereous, becoming paler on drying; stipe scarcely 1 mm. thick. — 3. *P. tenera.*
  Pileus some shade of brown.
    Pileus 2–4 mm. broad. — 4. *P. minima.*
    Pileus 8–12 mm. broad; decorated with erect hairs. — 5. *P. hirta.*
    Pileus 1–3 cm. broad.
      Stipe 3–4 mm. thick. — 6. *P. castaneicolor.*
      Stipe 1–2 mm. thick.
        Stipe white, glabrous. — 7. *P. betulina.*
        Stipe pale-brown, fibrillose. — 8. *P. Bartholomaei.*
Stipe 5–15 cm. long.
  Pileus bluish-white, with yellow disk. — 9. *P. gracillima.*
  Pileus whitish, becoming grayish. — 10. *P. debilis.*

Pileus grayish-black.
    Surface deeply radiate-sulcate. — 11. *P. Clementsii.*
    Surface smooth, not sulcate. — 12. *P. angusticeps.*
Pileus some shade of brown, yellowish-brown, or reddish-brown.
    Stipe 1–2 mm. thick.
        Stipe white. — 13. *P. atomata.*
        Stipe reddish-fulvous. — 14. *P. petasiformis.*
    Stipe 2–4 mm. thick.
        Stipe 5–8 cm. long.
            Lamellae crowded. — 15. *P. odorata.*
            Lamellae distant. — 16. *P. distantifolia.*
        Stipe 10–13 cm. long. — 17. *P. graciloides.*

1. PSATHYRELLA MINUTULA (Schaeff.) Murrill, Mycologia **10**: 26. 1918

Agaricus minutulus Schaeff. Fung. Bavar. Ind. 72. 1774.
Agaricus disseminatus Pers. Syn. Fung. 403. 1801.
Psathyrella disseminata Quél. Champ. Jura Vosg. 123. 1872.

Pileus membranaceous, ovoid-campanulate, densely gregarious or cespitose, 6–10 mm. broad; surface minutely scaly, becoming smooth, whitish, gray, or grayish-brown, often buff on the umbo, margin sulcate-plicate; context very thin, with mild taste and no odor; lamellae adnate, broad, subdistant, ventricose, white to gray, then black; spores ellipsoid, tapering at both ends, smooth, dark-purplish-brown in mass, chestnut-bay under the microscope, 8–9 x 4 μ; stipe furfuraceous to glabrous, white or yellowish to cinereous, very slender, becoming hollow, often curved, about 2.5 cm. long and 1 mm. thick.

TYPE LOCALITY: Bavaria.

HABITAT: On decayed wood and moist earth containing organic matter.

DISTRIBUTION: Cosmopolitan.

ILLUSTRATIONS: Atk. Stud. Am. Fungi, *f. 49;* Boud. Ic. Myc. *pl. 140;* Gill. Champ. Fr. *pl. 141* (*586*); Hard, Mushr. *f. 280;* Mycologia **6**: *pl. 132, f. 1;* Pat. Tab. Fung. *f. 351;* Schaeff. Fung. Bavar. *pl. 308;* Bull. U. S. Dept. Agr. 175: *pl. 29, f. 2.*

This very attractive little species was first described from Bavaria and accurately figured in color by Schaeffer. The synonymy is considerably complicated but it seems quite certain that the specific name under which the plant is best known has been in use

since 1801, when Persoon extended his former use of this name to include the juvenile form as figured by Schaeffer in his plate 308. The plant is widely distributed and very abundant, often occurring in one spot in such large numbers that it is practically impossible to count the dainty little caps. It may be looked for throughout the season from early summer until late autumn and often appears on the soil in greenhouses during the winter. The species strongly suggests *Coprinus,* both in its mode of expanding and in blackening with age, when the black spores are mature. The microscopic structure of the hymenium is also similar to that of *Coprinus;* and Lange has transferred it to that genus. Buller, however, criticizes him for so doing and advances several good reasons why it should remain in *Psathyrella.*

2. PSATHYRELLA LEUCOSTIGMA Peck, Bull. Torrey Club **22**: 490. 1895

Pileus submembranaceous, campanulate, 8–12 mm. broad; surface striate, bluish-white when fresh, changing to sepia-brown when dried, the apex remaining whitish; lamellae crowded, lead-colored when young, becoming black with age, whitish on the edges; spores ellipsoid, black, 12.5–15 x 7.5 μ; stipe slender, flexuous, hollow, white, 2.5–4 cm. long, about 2 mm. thick.

TYPE LOCALITY: Kansas.

HABITAT: On wet ground under trees.

DISTRIBUTION: Known only from the type locality.

The type specimens, collected by Bartholomew in July, do not appear to be either at Albany or in the Ellis Collection.

3. PSATHYRELLA TENERA Peck, Ann. Rep. N. Y. State Mus. **47**: 144. 1894

Pileus thin, campanulate, obtuse, 6–10 mm. broad; surface moist or subhygrophanous, reddish-cinereous when moist, paler when dry, slightly rugulose and atomate; lamellae broad, adnate, plane or but slightly ascending, subdistant, at first pallid or subcinereous, then umber and finally blackish, white on the edges; spores narrowly ellipsoid, 12–16 x 8–10 μ; stipe slender, glabrous, stuffed or hollow, white, with a white, floccose mycelium at the base, 2.5–4 cm. long, scarcely 1 mm. thick.

TYPE LOCALITY: Pierrepont Manor, Jefferson County, New York.

HABITAT: On damp mucky ground in open woods.

DISTRIBUTION: Known only from the type locality.

The type specimens, collected by Peck in June, are well preserved at Albany, and seem very near plants called *P. atomata* Fries by Bresadola. Specimens from Westport so named appear to be distinct.

4. PSATHYRELLA MINIMA Peck, Ann. Rep. N. Y. State Mus. **41**: 70. 1888

Pileus membranaceous, hemispheric, obtuse, 2–4 mm. broad; surface obscurely striatulate when moist, even and pruinose-atomate when dry, dingy-yellow or reddish-brown, becoming paler on drying; lamellae broad, adnate, white, becoming yellowish-cinnamon; spores narrowly ellipsoid, black, 6–8 x 3–4 μ; stipe capillary, minutely mealy or furfuraceous under the lens, pellucid, white, 8–12 mm. long.

TYPE LOCALITY: Adirondack Mountains, New York.

HABITAT: On manure in woods.

DISTRIBUTION: Known only from the type locality.

This tiny species is represented only by a few specimens collected by Peck in July and now attached to a sheet at Albany.

5. PSATHYRELLA HIRTA Peck, Ann. Rep. N. Y. State Mus. **50**: 107. 1897

Pileus thin, hemispheric, subcespitose, 8–12 mm. broad; surface hygrophanous, at first covered with erect, fascicled hairs, reddish-brown when moist, grayish-brown or whitish when dry; lamellae adnate or subdecurrent, subcrowded, broad, pallid to black; spores 12–14 x 6–7 μ; stipe flexuous, shining, white, hollow, squamose, 2.5–5 cm. long, 2–3 mm. thick.

TYPE LOCALITY: Minerva, New York.

HABITAT: On manured, shaded ground.

DISTRIBUTION: Known only from the type locality.

The type specimens collected by Peck are attached to a sheet at Albany. Others so named collected by Kellerman in October, 1906, in a greenhouse at Columbus, Ohio, appear to agree with the type of *P. Bartholomaei*.

6. **Psathyrella castaneicolor** sp. nov.

Pileus fleshy, hemispheric to expanded, 3 cm. broad; surface

hygrophanous, glabrous, sometimes having fragments of the white veil when very young, chestnut to tan, margin even, splitting; context thin, brownish, with mild but mawkish taste; lamellae sinuate-adnate, subcrowded, broad, plane, white to purplish, then black; spores ellipsoid or ovoid, smooth, opaque, sometimes apiculate, very dark-bay under the microscope, about 12 x 7 μ; stipe subcylindric, subglabrous, floccose above, hollow, white, 4 cm. long, 3–4 mm. thick.

TYPE LOCALITY: Redding, Connecticut.

HABITAT: On a pile of decaying leaves.

DISTRIBUTION: Known only from the type locality.

Type collected by F. S. Earle (*381*) on July 17, 1902.

7. PSATHYRELLA BETULINA Peck, Bull. Torrey Club 34: 101. 1907

Pileus thin, submembranaceous, fragile, conic or convex, sometimes broadly umbonate, 1–2.5 cm. broad; surface glabrous, atomate, hygrophanous, fuscous or dark-brown when moist, paler when dry; lamellae broad, adnate, subdistant, cinereous, becoming black, white on the edges; spores ellipsoid, black, 8–10 x 5–6 μ; stipe fragile, equal, hollow, glabrous, shining, white, 2.5–5 cm. long, 1–2 mm. thick.

TYPE LOCALITY: Stow, Massachusetts.

HABITAT: On decaying branches of white birch.

DISTRIBUTION: Known only from the type locality.

The type specimens are at Albany, collected by Simon Davis on September 26, 1906. They resemble species of *Atylospora*, but the spores are black.

8. PSATHYRELLA BARTHOLOMAEI Peck, Bull. Torrey Club 22: 490. 1895

Pileus thin, subconic or convex, 1.5–3 cm. broad; surface glabrous, striate on the margin, pale-brown; lamellae crowded, nearly plane, adnate, brownish, becoming black; spores ellipsoid, 10–13 x 5–6.5 μ; stipe slender, flexuous, hollow, adorned with a few grayish fibrils, pale-brown, 2.5–4 cm. long, scarcely 2 mm. thick.

TYPE LOCALITY: Rockport, Kansas.

HABITAT: On wet ground in woods; also in greenhouses.

DISTRIBUTION: Ohio and Kansas.

ILLUSTRATION: Hard, Mushr. *f. 281.*

The type specimens were collected by Bartholomew (*1838*) on July 28, 1895, and are in the Ellis Collection here. The Ohio plants were collected by Kellerman in October in a greenhouse at Columbus.

9. PSATHYRELLA GRACILLIMA Peck, Bull. Torrey Club **23**: 417. 1896

Pileus membranaceous, convex or nearly plane, 1.5–4 cm. broad; surface finely striate nearly to the disk, subhyaline, bluish-white with a pinkish tint, the disk yellow and commonly depressed; lamellae thin, crowded, rounded behind and adnexed or nearly free, light-slate-colored when young, becoming black or variegated with black; spores oblong-ellipsoid, pointed at one end, 13.5–15 x 6–7.5 μ; stipe slender, elongate, erect, hollow, whitish or cream-colored, 7.5–12.5 cm. long, about 2 mm. thick.

TYPE LOCALITY: Rooks County, Kansas.

HABITAT: On damp ground among weeds.

DISTRIBUTION: Pennsylvania and Kansas.

The type specimens sent to Peck by Bartholomew (*2201*) were collected on July 20, 1896. They resemble *Coprinus Spraguei*, but are larger. I found the species at Ohio Pyle, Pennsylvania, in July, 1905.

10. PSATHYRELLA DEBILIS Peck, Bull. Torrey Club **23**: 418. 1896

Pileus membranaceous, campanulate, umbonate, 1.5–3.5 cm. broad; surface striate nearly to the umbo, subhyaline, whitish, becoming grayish; lamellae adnate, thin, narrow, crowded, whitish when young, becoming black; spores broadly ellipsoid, 13 x 8 μ; stipe slender, weak, flexuous, white, hollow, never erect, 5–8 cm. long, 2–3.5 mm. thick.

TYPE LOCALITY: Rooks County, Kansas.

HABITAT: On damp ground, attached to decaying stems.

DISTRIBUTION: Known only from the type locality.

Collected by Bartholomew (*2199*) on July 20, 1896. A part of the type collection is at Albany and a part in the Ellis Collection here. According to Peck, the species suggests *Psathyra gyroflexa*, but differs in the umbonate pileus, the larger spores, and in having no purplish tint to the lamellae.

11. PSATHYRELLA CLEMENTSII Sacc. Syll. Fung. **14**: 163. 1899

Psathyrella sulcata Clements, Bot. Surv. Neb. **3**: 13. 1894. Not *P. sulcata* (Dunal) Sacc. 1887.

Pileus campanulate to expanded, 1–2.5 cm. broad; surface deeply radiate-sulcate, grayish-black, light-yellow on the umbo, pellucid; lamellae adnexed, subventricose, cinereous, black on the edges; spores ovoid-apiculate, purplish-brown, 8–10 x 5–6 μ; stipe slender, hollow, shining, white above, red below, 4–6 cm. long, 1–2 mm. thick.

TYPE LOCALITY: Lincoln, Nebraska.

HABITAT: On the ground.

DISTRIBUTION: Known only from the type locality.

The type specimens were collected by Clements. I have not seen them.

12. PSATHYRELLA ANGUSTICEPS Peck, Bull. Torrey Club 33: 217. 1906

Pileus very thin, membranaceous, conic or subcampanulate, subacute, often with a small but prominent umbo, gregarious, 1–2 cm. broad; surface hygrophanous, fragile, minutely flocculose, appendiculate with minute fragments of the whitish veil, sometimes striate on the margin, grayish-brown, whitish or grayish on the margin; lamellae ascending, thin, brittle, moderately crowded, adnate, pale-olive-green becoming darker and finally black; spores broadly-ellipsoid, black, abruptly-narrowed at the ends, 15–20 x 10–12 μ; stipe very long, slender, fibrous, rather tough, hollow, straight or nearly so, ashy-gray above, chestnut-colored below, sometimes slightly thicker toward the base, 5–9 cm. long, about 1 mm. thick.

TYPE LOCALITY: Falmouth, Massachusetts.

HABITAT: On grassy ground.

DISTRIBUTION: Known only from the type locality.

The type specimens, which are well preserved at Albany, were collected by Simon Davis on June 22, 1905. They resemble a narrow, unexpanded form of *Panaeolus campanulatus*.

13. PSATHYRELLA ATOMATA (Fries) Quél. Champ. Jura Vosg. 123. 1872

Agaricus atomatus Fries, Syst. Myc. 1: 298. 1821.

Pileus bell-shaped, obtuse, solitary or gregarious, 1–2.5 cm. broad; surface atomaceous, hygrophanous, livid, tan or pale-flesh-colored when dry; margin slightly striate, dry, even or wrinkled; lamellae adnate, subdistant, broad, ventricose, whitish to blackish; spores ovoid to ellipsoid, 13–15 x 6–8 μ; stipe equal, lax, slightly

bent, not rooting, pulverulent at the apex, tubular, white, 5 cm. long, 2 mm. thick.

TYPE LOCALITY: Europe.

HABITAT: On grassy ground along paths.

DISTRIBUTION: Northeastern United States; also in Europe.

ILLUSTRATIONS: G. Bernard, Champ. Rochelle *pl. 25, f. 5;* Cooke, Brit. Fungi *pl. 642* (*638*); Pat. Tab. Fung. *f. 236;* Saunders, Smith & Bennett, Myc. Illust. *pl. 37, f. 2.*

Described from Sweden, and reported from several parts of the United States by Ellis, Kellerman, Johnson, Bundy, and others. I have specimens from Paris and London, collected by myself, which agree with New York specimens collected by O. F. Cook. Peck's plants from West Albany so named are mounted and figured on a sheet with *P. graciloides,* which they much resemble.

14. **Psathyrella petasiformis** sp. nov.

Pileus conic to campanulate with conic umbo, becoming subexpanded with upturned edges, gregarious, reaching 2 cm. broad and about 1 cm. high; surface glabrous, hygrophanous, striatulate to the disk, fulvous with a reddish tint, fading to yellow except on the disk, margin thin, yellowish, slightly projecting; context very thin; lamellae adnate, crowded, inserted, grayish-olive to nearly black, whitish on the edges; spores oblong-ellipsoid, tapering at both ends, smooth, smoky-purplish-brown under the microscope, 8–10 x 4.5–5.5 μ; stipe cartilaginous, slightly fibrillose-scaly, fulvous with a reddish tint, hollow, about 5 cm. long and 1–2 mm. thick.

TYPE LOCALITY: Buck Hill Falls, Pennsylvania.

HABITAT: On much-decayed wood in woods.

DISTRIBUTION: Known only from the type locality.

Collected on August 28, 1921, by Mrs. John R. Delafield, who made good notes and a colored sketch from the fresh specimens. The specific name selected was suggested by the hat-shaped pileus.

15. PSATHYRELLA ODORATA (Peck) Sacc. Syll. Fung. 5: 1136. 1887

Agaricus odoratus Peck, Ann. Rep. N. Y. State Mus. 24: 70. 1872.

Pileus thin, fragile, ovoid-convex, at length expanded, gregarious or subcespitose, 2.5–5 cm. broad; surface smooth, hygrophanous, dark-reddish-brown and striatulate on the margin when

moist, dirty-white or clay-colored with a pinkish tint, subatomaceous and radiately-rugose when dry; context having a strong odor resembling that of *Sambucus pubens;* lamellae crowded, broad, attached, with a slight spurious decurrent tooth, dingy-flesh-colored, then rosy-brown, finally black with whitish edges; spores ellipsoid-cymbiform, 9 μ long; stipe pallid, equal, hollow, slightly enlarged at the base, slightly mealy and striate at the apex, subfibrillose when young, 5–8 cm. long, 2–4 mm. thick.

TYPE LOCALITY: West Albany, New York.

HABITAT: About manure heaps.

DISTRIBUTION: Known only from the type locality.

The type specimens at Albany, collected by Peck in May, are attached to a sheet and fairly well preserved. He seems to have found it in quantity. *Psilocybe atomatoides* seems very close.

16. **Psathyrella distantifolia** sp. nov.

Pileus convex to expanded, becoming slightly depressed at the center at times, solitary, about 3 cm. broad; surface dry or slightly hygrophanous, glabrous, conspicuously striate, dark-isabelline to fuliginous; lamellae adnate or sinuate, broad, distant, becoming dark-fumosus to almost ater, whitish on the edges; spores narrowly-ellipsoid, sometimes apiculate, smooth, opaque, dark-bay under the microscope, about 10 x 5 μ; stipe slender, equal, smooth, white, glabrous, hollow, about 7 cm. long, 2–3 mm. thick.

TYPE LOCALITY: Bronx Park, New York City.

HABITAT: On loam in woods.

DISTRIBUTION: Known only from the type locality.

The type specimens were collected by myself on September 10, 1911, and a photograph taken of them. This species is rather near *Psilocybe atomatoides* but the gills are more distant and the spores larger and darker.

17. PSATHYRELLA GRACILOIDES (Peck) Sacc. Syll. Fung. 5: 1127. 1887

Agaricus graciloides Peck, Ann. Rep. N. Y. State Mus. 30: 42. 1878.

Pileus thin, conic or campanulate, gregarious, 2.5 cm. broad; surface glabrous, hygrophanous, brown and striatulate when moist, whitish and subrugulose when dry; lamellae ascending, rather broad, subdistant, brown, becoming blackish-brown, whitish on the edges; spores ellipsoid, blackish, 12–16 x 8–10 μ; stipe long,

straight, fragile, hollow, smooth, white, 10–13 cm. long, 2–4 mm. thick.

TYPE LOCALITY: Maryland, New York.

HABITAT: On the ground in an old dooryard.

DISTRIBUTION: New York.

ILLUSTRATION: Ann. Rep. N. Y. State Mus. 30: *pl. 1, f. 1–4.*

Type specimens were collected by Peck in September. Figured specimens attached to a sheet are from Knowersville and were called "*P. gracilis* Fr." Half a dozen other collections from New York appear to match the type. *P. debilis* does not seem very distinct.

DOUBTFUL SPECIES

Psathyrella crenata (Lasch) Fries, Hymen. Eur. 315. 1874. Kauffman refers a Michigan plant to this species, citing differences, and adding that it agrees well with Cooke's figure.

Psathyrella falcifolia (Mont.) Sacc. Syll. Fung. 5: 1134. 1887. (*Agaricus falcifolius* Mont. Syll. Crypt. 127. 1856.) Described from specimens collected by Sullivant at Columbus, Ohio, growing in clusters on logs and dead leaves. Type not seen.

Psathyrella hiascens (Fries) Quél. Champ. Jura Vosg. 123. 1872. (*Agaricus hiascens* Fries, Syst. Myc. 1: 303. 1821.) Peck reported this species from New York on the basis of specimens collected by him in June under willows at West Albany, and drawn in color. They are thin, campanulate, and multistriate, with very long, slender stipes;—quite different in appearance from the drawings made by Oersted in Costa Rica. The spores of Peck's specimens are said to measure 12–16 x 8–10 μ.

Psathyrella rupincola (Mont.) Sacc. Syll. Fung. 5: 1129. 1887. (*Agaricus rupincola* Mont. Syll. Crypt. 127. 1856.) Described from specimens collected at Columbus, Ohio, by Sullivant, in May, growing from fissures in rocks. Type not seen.

NEW COMBINATIONS

For the convenience of those who prefer to use the older nomenclature, the following species described as new in *Atylospora* are transferred to *Psathyra:*

ATYLOSPORA AUSTRALIS = **Psathyra australis**
ATYLOSPORA PRUNULIFORMIS = **Psathyra prunuliformis**
ATYLOSPORA STRIATULA = **Psathyra striatula**

NEW YORK BOTANICAL GARDEN.

UROCYSTIS AGROPYRI ON REDTOP

W. H. Davis

(With Text Figure 1)

On June 6, 1921, smutted plants of redtop, *Agrostis palustris* Huds. (*A. alba* L.), were collected at Madison, Wisconsin, and microscopic examination showed the smut to be *Urocystis agropyri* (Pruss.) Schroet.

The hosts and host ranges reported by Clinton in *North American Flora* 7: 58. 1906 are as follows: *Agropyron divergens* Nees (*Agropyron spicatum* (Pursh) Scribn. & Smith), Washington; *A. occidentale* Scribn. (*A. smithii* Rydb.), New Mexico; *A. repens* (L.) Beauv., Connecticut, Massachusetts and Vermont; *Bromus ciliatus* L., Iowa; *Bromus* sp., Minnesota; *Calamagrostis canadensis* (Michx.) Beauv., Oregon; *Elymus arenarius* L., Greenland; *E. canadensis* L., Illinois, Iowa, Kansas, Missouri, Nebraska and Wisconsin; *E. robustus* Scribn. & Smith; *E. virginicus* L., Illinois and Wisconsin; *E. sp.*, Colorado and Minnesota.

On redtop, the general appearance of the sori on the parts of the plant is the same as described for other hosts. The pustules form on the exposed culm, leaf sheath and blade, rhachis and rhachilla and are especially numerous on the leaves near the top of the culm. Striae, varying from 0.5 mm. in length to that of the whole leaf, form between the leaf veins. When young, these striae are raised and covered with light-colored, epidermal tissue of the host which later ruptures forming a trough-like slit filled with the spore balls. After the dispersal of the spore balls, the tissues beneath the striae become transparent and finally the leaves are shredded longitudinally. The culm above the sheath of the last leaf is usually twisted and the black pustules either remain distinct or coalesce on small areas of the culm. Although the plants when observed were only partially in blossom, many of the highly in-

fected panicles and some of the infected, lower leaves of the younger stools were dead.

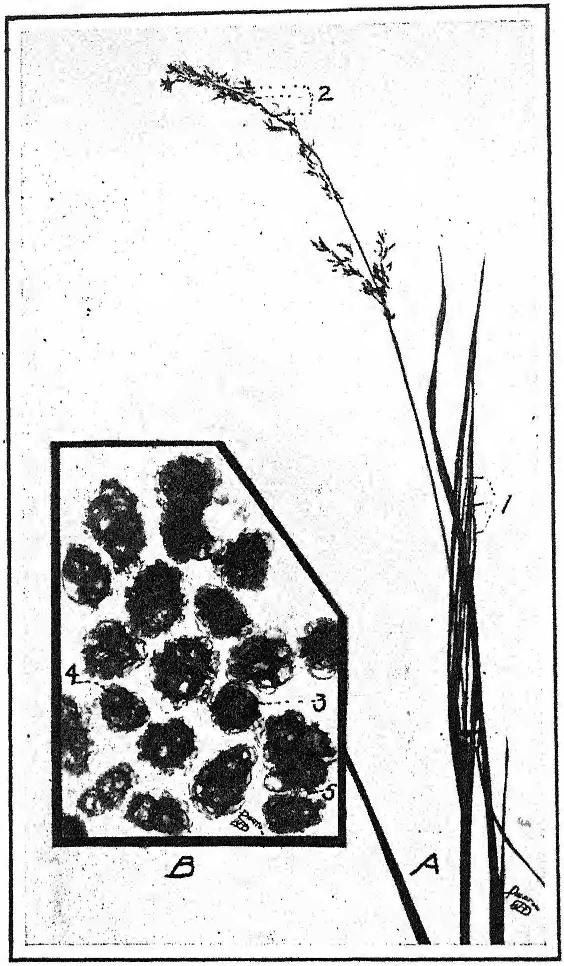


Fig. 1. *Urocystis agropyri* (Pruss.) Schroet. on redtop. *A*. Smutted redtop plant (× 0.5), showing (1) shredding of leaf between the veins where the spore balls are deposited; (2) twisting of rachis. *B*. Photomicrograph of spore balls from the redtop plant shown in *A* (× 400); (3) spore ball containing one fertile spore; (4) two fertile spores; (5) four fertile spores.

The spore balls are oblong-spheric to spheric, from 21 to 33 μ in length, occasionally 40 μ. The sterile cells vary from a very

light amber to a Brussels-brown, are oblong-spheric to sub-spheric, covering the fertile cell or cells. The spores vary from 1 to 4 in a spore ball, usually 1 or 2. The fertile spores are Brussels-brown, oblong-spheric to spheric or angular-spheric. The sides of the spores are often flattened where two or more are crowded together in a spore ball. The spores are 12 to 19 μ in length; the average length of 20 measured was 16 μ. Thus the spores and spore balls compare very favorably with those of *U. agropyri* as described by Clinton (l. c.).

Specimens were deposited in the Herbarium at the University of Wisconsin. The identification of the smut was verified by Dr. J. J. Davis, Curator of the Herbarium at the University of Wisconsin.

DEPARTMENT OF BOTANY,
MASS. AGR. COLLEGE,
AMHERST, MASS.

NEW JAPANESE FUNGI

NOTES AND TRANSLATIONS—XII

Tyôzaburô Tanaka

Gymnosporangium asiaticum Miyabe in Shokubutsugaku Zasshi (Bot. Mag.) Tôkyô, 17^{192}: 34. M. 36, ii, Feb., 1903 (nomen nudum); in Ideta's Nippon Shokubutsu Byôrigaku (Handb. Pl. Diseases in Japan) ed. 3, Tôkyô, Shôkwabô, M. 36, iv, Apr., 1903, 6. 214–217, fig. 50, 51 (nomen subnudum); Yamada in Ômori, J. & Yamada, G. Shokubutsu Byôrigaku (Plant Pathology) Tôkyô, Hakubunkwan, M. 37, ix, Sept., 1904, p. 303–306. (Japanese.)

Description by G. Yamada:

O. Pycnia epiphyllous on spots, first small, punctiform and orange-yellow, gregarious, few in number; pycnospores small, fusoid.

I. Aecia hypophyllous, on thickened, well-developed, brown spots having a beautiful, flavo-rubescent margin, very slender, 3–6 mm. high, cinereous; peridium tubular, not recurved in dehiscence, irregularly torn at the end, liberating reddish-brown aeciospores; aeciospores globose or sub-angular, minutely-verrucose, the pores several.

On *Pyrus sinensis* (Japanese sand-pear) and *Cydonia vulgaris.*

III. Telia foliicolous, forming reddish-brown, gelatinous masses, deep-fuscous when desiccated, pulvinate with sticky, orange-yellow teliospores; teliospores long-pediceled, orange-yellow, those produced on the outer part of the telium broad and short, thick-walled and deep colored, those formed in the inner part of the telium slender, thin-walled and light colored, readily germinating from the places near the septum; promycelia 1–2, rarely produced from the apex of the teliospore; sporidia 2–3 on a promycelium.

On *Juniperus chinensis* and *J. chinensis* var. *procumbens.*

The sporidia of III readily produce *Roestelia* (*R. koreaensis* P. Henn.) on Japanese pear leaves, according to the inoculation test conducted by Miyabe.

Ideta (under supervision of Miyabe) gives the spore characters as follows: "Teliospores 2-celled, fusoid, 45–70 x 20–25 μ, long-pediceled." (*In* Nippon Shokubutsu Byôrigaku ed. 4, pt. 2: 470. M. 44, 1911. Japanese.)

Notes: Sydow first described *Gymnosporangium japonicum* from the specimens on the branch of *Juniperus chinensis* collected by Shirai at Komaba, Tôkyô (*in* Hedwigia, Beibl. 38^3: (141) May–June, 1899), and later, Shirai succeeded in producing *Roestelia* (*R. koreaensis*) on Japanese pear leaves by inoculating with some mixed forms of *Gymnosporangium* found on the leaves and stems of *Juniperus chinensis,* and which he called *G. japonicum* (*in* Zeitsch. f. Pflkr. 10^1: 1–4, pls. 1–2. Apr., 1900). These results apparently induced many Japanese pathologists to believe that *G. japonicum* is the causal organism of the devastating Japanese pear-rust, though Miyabe clearly defines that *G. asiaticum* occurs only on the leaves. The first comprehensive description of *G. asiaticum* given by Yamada also limits the occurrence of the telia to the juniper leaf only, and Yoshino later showed that the pear-rust is caused only by the leaf-inhabiting form of *Gymnosporangium* (*G. asiaticum*) in the Kyûshû island, and not by the stem-inhabiting form which he never found existing in the island (*in* Shokubutsu-gaku Zasshi, Bot. Mag., Tôkyô, 19^{222}: 167–168. M. 38, vii, July, 1905. Japanese). Ideta also describes the telial stage from the leaf-inhabiting form only, though he was liberal in bringing the name *G. asiaticum* into the synonymy with *G. japonicum* in his latest description (l. c. ed. 4, pt. 2: 467, 469–470. 1911).

Despite the existence of the valid name *Gymnosporangium asiaticum* applied to the form on the juniper leaves, Sydow renamed the leaf-inhabiting form as *Gymnosporangium haraeanum,* based upon the material collected by K. Hara from Mino province (*in* Ann. Mycol. 10^4: 405. Aug., 1912). Using the fresh material taken from the juniper plant upon which Sydow's type was collected, Hara succeeded in producing pear-rust by inoculation (*in* Shokubutsugaku Zasshi 27^{319}: 348. T. 2, vii, July, 1913. Japanese). At the same time, Itô succeeded in producing rust on *Photinia villosa* by inoculating the stem-inhabiting form which he determined to be *G. japonicum* Syd. (*in* Shok. Zass. 27^{323}: 221–

222. Nov., 1913). Itô concludes, therefore, that the leaf-inhabiting *Gymnosporangium* (*G. haraeanum* = *G. asiaticum*) is the cause of the Japanese pear-rust (*Roestelia koreaensis*), while the stem-inhabiting form (*G. japonicum*) is connected with the *Photinia* rust (*Roestelia photiniae* P. Henn.). (*See* l. c. p. 221, and also *in* Byôchû-gai Zasshi, Journ. Pl. Prot. 4^3: 178–182. T. 6, iii, Mar., 1917. Japanese.) Jackson also succeeded in infecting sand-pear and quince with the teliospores from *Gymnosporangium koreaensis* Jacks. (= *G. asiaticum* = *G. haraeanum*) and recommended *G. photiniae* Kern (*in* Bull. N. Y. Bot. Gard. **7**: 443. Oct., 1911) to supersede *G. japonicum*, following Itô's successful inoculation. (*See* Journ. Agr. Res. **5**: 1006, 1007. Feb., 1916.) Dietel, on the other hand, made examination of aecia found on the leaves of *Cydonia vulgaris*, *Pirus sinensis* and *Pourthiaea villosa* (*Photinia villosa*) collected by Kusano at the Botanic Garden, Tôkyô, and brought altogether under one species *G. confusum* Plowr. (*in* Engler's Bot. Jahrb. 28^3: 286, May, 1900), but Itô states that *G. confusum* never occurs in Japan, though Shirai lists it in his Nippon Kinrui Mokuroku (A list of Japanese fungi hitherto known, Tôkyô, Nippon Engei Kenkyûkwai, M. 38, 1905, p. 39) and he also maintains that the first two must be identical with *G. asiaticum* and the third must be *G. japonicum* (*in* Byôchû-gai Zasshi 4^3: 180. Mar., 1917).

In Korea, pear-rust was known quite early and its connection with juniper was suspected by the Korean agriculturist Soh You-Koh in his work *Haing po chi* written as early as about 1845. (Shirai, *in* Ann. Phytopath. Soc., Japan 1^1: 2. Jan., 1918.) In Japan, Hori first noticed the connection of the pear-rust with juniper *Gymnosporangium* in 1892, and he studied the actual damage of the pear plantation in Okayama first in 1900. (*See* Hori's Shokubutsu Byôgai Kôwa [Lectures on plant diseases] v. 2. Tôkyô, Seibidô, t. 5, xi, Nov., 1916, p. 301–302 [Japanese].) The infection of quince (*Cydonia vulgaris*) by the pear-rust fungus was reported by Miyabe and all later investigators, but Sydow made it a new species giving the name *Gymnosporangium spiniferum* to the aecial stage. (*See* Ann. Mycol. **10**: 78. Feb., 1912.) Itô conceives this to be identical with *G. asiaticum* (l. c. p. 181), but

Kern brings this into the synonymy with *G. photiniae* (*in* Mem. N. Y. Bot. Gard. **6**: 246. Aug., 1916). Successful inoculation of *Cydonia japonica* by the pear *Gymnosporangium* was also reported by Yoshino (l. c. p. 168), Hori (l. c. p. 309) and Itô (l. c. p. 182). According to Yoshino (*in* Shok. Zass. 20^{232}: 91. M. 39, v, May, 1906. Japanese), Ideta (l. c. ed. 4, p. 467) and Itô (l. c. 4^{5}: 327), natural infection of European pear (*Pyrus communis*) is found but of slight extent, and Hori adds *Pyrus Toringo* and *Cydonia sinensis* as incidental hosts (*in* Hori's Nôsakumotsu Byôgaku, [Discourse on plant diseases], 7 impr. 1911. p. 292. Japanese). Ideta first reported that *G. asiaticum* occurs also on the leaves and stems of *Juniperus rigida* (*in* Shok. Zass. 18^{211}: 157–158. M. 37, viii, Aug., 1904. Japanese), but later he corrected the statement in accordance with Miyabe's inoculation tests, that the leaf-inhabiting form only can produce aecia on pear leaves (l. c. 18^{213}: 223. Oct., 1904. Japanese). Later investigators all agreed with Ideta's final statement (*see* Hara, in Engei no Tomo [Friend of Hort.] 13^{9}: 811–812. T. 6, ix, Sept., 1917. Japanese), except Itô who doubts these statements because only exceptional species can infect both the Sabina and Oxycedrus groups of juniper (*in* Byôchû-gai Zasshi 4^{3}: 182–183). R. Nodzu even suggested that the pear-rust infects several species of *Chamaecyparis* (*in* Shimane Kenritsu Nôji Shikenjô T. 4 Nendo Gyômu Kôtei, [Ann. Rept. Simane Agr. Exp. Stat. for 1915]. p. 93. Japanese), but his suggestion received little credit by succeeding authors. Yoshino, on the other hand, succeeded in obtaining rust on *Cydonia vulgaris, C. japonica* and the Japanese pear by infecting with a *Gymnosporangium* found on the small stems of *Juniperus chinensis* in the Saga prefecture (*in* Shok. Zass. 20^{232}: 91. May, 1906). He describes this stem-inhabiting telium as being "only swollen or expanded or globular, appearing quite different from the ordinary stem-inhabiting form which expands greatly with moisture into a tongue-like petal." This shows, according to Yoshino, that the telium of *G. asiaticum* occurs also on the small twigs of juniper in a form quite distinct from that of *G. japonicum*.

GYMNOSPORANGIUM YAMADAE Miyabe in Shokubutsugaku Zasshi (Bot. Mag.) Tôkyô, 17^{192}: 34–35. M. 36, ii, Feb., 1903 (nomen

nudum); Yamada in Ômori, J. & Yamada, G. Shokubutsu Byôrigaku (Plant Pathology) Tôkyô, Hakubunkwan, M. 37, 1904, p. 306–308, fig. 38 (Japanese).

Gymnosporangium Yamadai Miyabe ex Ideta in Nippon Shokubutsu Byôrigaku (Handb. Pl. Diseases in Japan) ed. 3, Tôkyô, Shôkwabô, M. 36, iv, Apr., 1903 (nomen subnudum); Miyabe *in* Ideta ditto ed. 4, pt. 2: 471–474, fig. 174. M. 44, 1911 (Japanese).

Description by G. Yamada and K. Miyabe combined:

I. Aecia hypophyllous, on more or less thickened, reddish-brown spots, cylindrical, thick, 0.4–0.5 mm. in diam., 5–8 mm. high; peridium fulvous, splitting into a fine lace-like network; peridial cells narrow and elongated, 60–80 x 20–24 μ, inner wall smooth, outer wall slightly verrucose, side wall tuberculate with short papillae and never making elongated ridges; aeciospores subglobose or polygonal, 16–24 μ in diam., wall thick, brown, finely verrucose, the pores 8, scattered.

On *Pyrus Malus* (Apple), *Pyrus spectabilis,* and *P. Toringo.*

III. Telia caulicolous, from a perennial mycelium, appearing on reddish-brown, spheric swellings of the host stem, of somewhat shining appearance, disclosed by the rupturing of the cork in irregular fissures, flavo-rubescent, flat, petal- or tongue-shaped, irregular, deep-fuscous when desiccated; teliospores 2-celled, oblong, broad-ellipsoid, obovoid or clavate, upper cell always larger, frequently with thick-walled, obtuse papilla at the apex, 40–50 x 15–22 μ.

On *Juniperus chinensis* and *J. chinensis* var. *procumbens.*

Apple culture of the northeastern territories has been menaced by the disease. In Sapporo, Hokkaidô, it made its first appearance in 1902 with the introduction of *J. chinensis,* carrying the fungus from the south. According to Ideta (l. c. ed. 4 p. 472), Miyabe first found in 1904 the connection of apple rust with this particular *Gymnosporangium* inhabiting on the juniper stems. The aecial stage develops in July and August causing discoloration of apple leaves, which frequently results in defoliation. The telial stage appears on the juniper in April or May in the main island, and in May or June at Sapporo, Hokkaidô.

Illustrations: 4 text-figures by Yamada (l. c. p. 307) are given, showing telia on juniper branch, cross section on the swollen stem, teliospores and germination of teliospores.

Notes: The finding of aecia on *Pyrus spectabilis* by Shirai in Tôkyô was reported by Dietel as ? *Gymnosporangium claviaeforme* Jacq. (*in* Hedwigia **37**: 216. July, 1898) and by P. Sydow as *Gymnosporangium* ? *clavariiforme* (Jacq.) Rees (do. Beibl. 37^{7}: (207) Nov.–Dec., 1898). P. Hennings listed an aecium on *Pyrus Toringo* collected by Shirai at Nikkô as ? *G. clavariiforme* (Jacq.) Rees (*in* Engler's Bot. Jahrb. **28**: 262. Mar., 1900), and he later reported *G. clavariiforme* from Tôkyô, found by Hori on *P. spectabilis* (do. 31^{4-5}: 732. Aug., 1902). These are all likely to represent *G. Yamadae*. Under *G. Yamadae* Miyabe sp. nov., Kern presented a description of the aecial stage found on *Pyrus spectabilis* by Nambu at Tôkyô (*in* Bull. N. Y. Bot. Gard. 7^{26}: 466. Oct., 1911), and Sydow later described the telial stage under the same name from material presented by M. Miura (*in* Ann. Mycol. **12**: 159–160. Apr., 1914). Itô (*in* Byôchû-gai Zasshi, Journ. Pl. Prot. 4^{4}: 244–245. Apr., 1917) ventured, however, to bring this name into the synonymy with *G. chinensis* Long (*in* Journ. Agr. Res. **1**: 345. Jan., 1914) but all later investigators have considered the latter to be identical to *G. asiaticum* (= *G. haraeanum* = *G. koreaensis*). *See* Clinton, *in* Ann. Rept. Conn. Agr. Exp. Stat. for 1914 p. 15, 16. 1914; Jackson, *in* Journ. Agr. Res. **5**: 1006. Feb., 1916 and Kern *in* Mem. N. Y. Bot. Gard. **6**: 247–249. Aug., 1916.

GYMNOSPORANGIUM IDETAE Yamada ex K. Hara in Hara's Kwaju Byôgairon (Discourse on fruit diseases) Irie-chô, Shidzuoka-ken, T. 5, xi, Nov., 1916. p. 95 (Japanese): in Shidzuoka-ken Nôkwaihô (Journ. Agr. Soc., Shidzuoka prefecture) no. 287: 51–52. T. 10, ix, Sept., 1921 (Japanese).

Description from Hara's second article:

O. Pycnia epiphyllous, immersed, on orbicular or irregularly-orbicular orange-yellow spots of 5–15 mm. broad, which later turn into beautiful reddish-brown color, globose, with pointed apex; pycnospores fusoid, exude with mucilaginous substance, 8–10 x 3–3.5 μ.

I. Aecia gregarious, protruding from the host tissue, often with common base, cylindrical, grayish-yellow, with apex first rounded, later lacerating, 1–3 x 0.3–0.6 mm.; aeciospores broad-ellipsoid, globose or subangular, grayish-brown, verrucose, 18–28 μ in diam.

On *Amelanchier asiatica,* collected by Hara in Kawauye-mura, prov. Mino (Gifu-ken).

Description from Hara's first article:

III. Telia caulicolous, formed on fusoid swellings, roughened at first, later lacerate, exposed as purplish-brown masses; teliospores cylindric-clavate or rarely subfusoid, 1-septate, upper cell being broader and shorter, 45–75 x 15–20 μ, wall 1.5 μ thick, the pores 2 in both upper and lower cells near the septum, or 1 apically in the upper and 2 in the lower cell, germinating mostly from the apical pore; sporidia ellipsoid, ovoid or globose, 12–15 x 7–10 μ.

On *Juniperus rigida.*

Revised description of III in the second article of Hara:

"Telial masses chestnut-brown or purplish-brown, at first hemispheric, later becoming flat by union, or liquify, varying in size, smallest about 5 mm. in diam., largest several inches broad, occasionally surrounding the twig; teliospores 2-celled, rarely 1- or 3-celled; 2-celled spores with thick, colored wall, ellipsoid, broad-ellipsoid, subfusoid or ovoid, the cells equal in shape but lower cell being a little longer and narrower than the upper, upper cell occasionally papillate, not constricted or slightly constricted, both ends rounded or narrowed, 35–50 x 20–25 μ, those round ones measuring 28–33 x 18–28 μ, wall 1.5 μ thick, the pores 2 or 1, mostly one apical in the upper cell, two lateral near the septum in the lower cell; colorless spores ellipsoid, cylindrical or fusoid, the cells unequal, upper cell larger and flatter, lower cell cylindrical or tapering toward the pedicel, 50–55 x 16–23 μ, wall 1 μ thick, the pores one apical in the upper cell, or two near the septum as in the lower cell; 3-celled spores elongated, contents brown or yellow-rust color, 1-nucleate, 65–75 x 18–20 μ; pedicels cylindrical, very long, hyaline, 3–5 μ thick; promycelia clavate or cylindrical, 3-septate; sterigmata 3–4; sporidia ellipsoid ovoid or reniform, 10–15 x 7–10 μ."

Related to *G. Miyabei* Yamada & Miyake much closer than to *G. japonicum* Syd. Inoculations by Yamada and by Hara, conducted independently, resulted in the formation of aecia on *Amelanchier asiatica.*

Notes: The telial stage found on *Juniperus rigida* was first identified as *G. tremelloides* Hart. (Hara in Shok. Zass. 27^{313}:

67. T. 2, i, Jan., 1913. Japanese). This identification was made by Sydow according to Hara's second report (l. c. 27^{319}: 348. T. 2, vii, July, 1913. Japanese), but as he had formerly succeeded in inoculating *Amelanchier* he considered this to be identical, at least partly, to *G. juniperinum* mentioned by Shirai in his "List" p. 39. Hara later obtained materials from Yamada who proposed the present scientific name according to the results of his inoculation. *See* Engei no Tomo (Friend of Hort.) 13^{9}: 812. T. 6, ix, Sept., 1917 (Japanese).

The present species was later acknowledged by Itô as a distinct species, differing from *G. clavariiforme* by having much flatter telia; from *G. amelanchieris* in the elongated shape of the teliospores; and from *G. clavipes* in the different shape of the pedicel of the teliospores. *See* Byôchû-gai Zasshi (Journ. Pl. Prot.) 4^{5}: 325–326. T. 6, v, May, 1917 (Japanese).

Hara's descriptions are based upon the specimens collected at Kawauye-mura, Minô province (Gifu-ken) (O. I. III.); various localities in Tôtômi province (Shidzuoka-ken) as Sakabe, Makinohara, Kasuisai, and Mikatagahara (III.).

Illustrations: Fig. 11, no. 6 in Hara's Kwaju Byôgairon shows 2 germinating teliospores and 2 sporidia.

GYMNOSPORANGIUM HEMISPHAERICUM K. Hara sp. nov. in Engei no Tomo (Friend of Hort.) 13^{9}: 813. T. 6, ix, Sept., 1917 (nomen nudum); in Dainippon Sanrin Kwaihô (Journ. Forest. Soc., Japan) no. 419: 16–18. T. 6, x, Oct., 1917. (Japanese.)

O. Pycnia epiphyllous, on orbicular orange-yellow spots, gregarious, first immersed, later piercing the epidermis with ostiola erumpent, globose or depressed-globose, 125–170 μ in diam., ostiolar filaments hyaline, resembling pedicels of pycnospores; pycnospores fusoid or ellipsoid, hyaline, 10–13 x 2.5–3 μ; pedicels filiform, 50–80 x 1–1.5 μ.

I. Aecia hypophyllous, cespitose or simply aggregate, conical or subcylindrical, delicate, brown, later cinereous or flavescent, 1–1.5 mm. high; peridium dehiscent only at the end; aeciospores globose or sub-angular, fulvous, verrucose, 20–28 x 18–25 μ.

On *Pyrus Zumi.*

Spots at first orange-yellow or yellowish-pink, orbicular, 1.5 mm. in diam., later enlarging attaining to 6 mm., becoming viscid and

then black-spotted on the upper surface, and producing hair-like aecia on the lower surface. At this stage, there develops a discolored area of pale-yellow or occasionally light-pinkish color around the spot.

III. Telia foliicolous or caulicolous, arising between scale-like leaves, oblate or hemispherical, fuscous or purplish-brown, later pulvinate, 1–5 mm. when desiccated, attaining to soy-bean size with moisture; teliospores subglobose, broad-ellipsoid or fusoid, rounded at both ends, sometimes papillate at the apex, occasionally with narrowed base, 2-celled, the cells almost equal-sized, constricted, 30–35 x 25–30 μ, wall thin, 1–1.5 μ thick, the pores 2 in each cell near the septum, or 1 apically in the upper, 2 in the lower cell; colorless spores fusoid or ellipsoid, commonly narrowed at both ends, 2-celled, each cell unequal, upper cell being 2–4 μ shorter than the lower, slightly or not constricted, 30–37 x 17–25 μ, wall thin, 1 μ thick, the pores 1 apical or 1–2 lateral in the upper, and 1–2 lateral in the lower cell, lateral pores being located near the septum; 1-celled teliospores ellipsoid or ovoid, rounded at both ends, or papillate at the apex, wall colored, 1–2 μ thick, the pores apical or lateral; pedicels cylindrical, long, 3–4.5 μ thick; promycelia cylindrical or elongated like hyphae, curved, 3-septate, 10–12 μ in diam.; sterigmata 3–4 on a promycelium, cylindrical, 5–6 μ long; sporidia ellipsoid or ovoid, 10–13 x 9–10 μ.

On *Juniperus chinensis.*

Type locality: Mino province (Gifu-ken) Kawauye-mura, Mar., 1917 (K. Hara).

The telia received a preliminary identification as *G. haraeanum* by T. Hemmi and S. Itô, but after examining well-developed teliospores Hara became aware of its great difference from common pear-rust *Gymnosporangium* and thought it to be a new form. The inoculation was then carried out and he obtained positive results on *P. Zumi,* and negative on *P. Malus, P. Toringo* and *P. sinensis.* Hara also collected aecia from naturally infected *P. Zumi* in August, 1916.

Hara observed, on the other hand, a type of sorus arising from the space between the scaly leaves of juniper, in this respect similar to a telium. This form, becoming globose or hemispheric in shape, is much lighter in color than the telium, being brown or rust-colored, pulvinate, composed of numerous spores arranged in

chains on the pedicel 3–4.5 μ thick (sometimes attaining to 9 μ thick in absorbing moisture). The spores are globose or broad-ellipsoid, 20–26 μ in diam., wall is thick, dark brown, 1.5–2 μ thick, contents being granular, rust-colored. In cutting the sori longitudinally, well-developed hyphae were observed, which were either apparently filling the enlarged host cells or running between them. The hyphae were colorless or fulvous, branching, 2–2.5 μ in diam. The spores did not germinate after several attempts, and that led Hara to consider these to be rudimentary urediniospores which had probably lost their function. He states that these peculiar spores occur also in the telia without forming independent sori of their own. He also ventures to add an account of this form to the generic character of *Gymnosporangium*. *See* Byôchû-gai Zasshi (Journ. Pl. Prot.) 6^9: 754–755. T. 8, ix, Sept., 1919. (Japanese.)

GYMNOSPORANGIUM SHIRAIANUM K. Hara sp. nov. in Byôchû-gai Zasshi (Journ. Pl. Prot.) 6^8: 681–687, 6^9: 751–756. 1 pl. T. 8, viii–ix, Aug.–Sept., 1919. (Japanese.)

O. Pycnia epiphyllous, on orange-red or reddish spots of 5–10 mm. broad, immersed, globose or depressed-globose, 150–200 μ in diam., ostiolar filaments needle-shaped, narrowed at the apex, straight, containing orange-colored granules, 80–120 x 3–4 μ; pycnospores cylindric or ellipsoid, narrowed at both ends, hyaline, 8–12 x 3–4 μ; pedicels linear, narrowed at the apex, hyaline, 15–30 x 2.5–3 μ.

I. Aecia hypophyllous, on 7–10-times thickened spots, the surface of which undulate, orange-yellow with margin of orange or reddish color, cespitose in small group or irregularly scattered, at first cinereous with purplish-yellow, simply projecting, later elongating into cylinder or tube, 0.25–0.5 mm. in diam., 1–5 mm. high; peridium straight or curved, at first with rounded end, later dehiscent; peridial cells sub-hexagonal, elongated, or fusoid, rarely subglobose, lower ones much shorter and light-brown in color, 33–90 x 20–40 μ, outer wall parallel-striated, 4–7 μ thick; aeciospores globose, ovoid or polygonal, fulvous, 18–23 x 16–18 μ, wall verrucose, 1–2 μ thick, the pores 6–14, pedicel linear, variable in length, 4–5 μ in diam.

On *Pyrus sinensis*.

Type locality: Tôtômi province (Shidzuoka-ken) Mikatagahara, June 6, 1919 (K. Hara).

III. Telia foliicolous, epiphyllous, solitary or rarely 2–3 together, first subepidermal, later erumpent, minute, depressed-globose or oblate-ellipsoid, upper surface convex, purplish-brown or castaneous, lower surface more or less flat, light-brown or light-colored, looking as though attached to the substratum with pedicel-like body, 1–3 mm. in diam., 0.5–1 mm. high, becoming honey-color with moisture; teliospores broad-ellipsoid, fusoid or ovoid, rounded or narrowed at both ends, sometimes pointed at the apex, 2-celled (rarely 3- or 1-celled), usually equal-sized, sometimes upper cell being broader and shorter, lower just opposite, or rarely vice versa, constricted or not constricted, 30–50 x 15–25 μ, wall castaneous, 1.5–2.5 μ, the pores 2 in each cell near the septum, or 1 apically in the upper, 2 laterally in the lower cell; colorless spores oblong short-cylindrical or fusoid, rounded or narrowed at both ends, 2-celled, the cells equal or unequal, upper being larger or just opposite, mostly not constricted but rarely much constricted, wall fulvous, 1 μ thick, the pores mostly 1 apically in the upper, 2 laterally in the lower cell, or 2 in each cell near the septum; 3-celled spores clavate or oblong, not constricted at the septum or slightly constricted, 64–66 x 15–18 μ; 1-celled spores globose, ovoid or ellipsoid, 22–25 x 20–22 μ, round ones 22 μ in diam., wall 2–2.5 μ thick; pedicels cylindrical, very long, 4–9 μ thick, hyaline; promycelia at first cylindrical, later occasionally elongate into hyphal form of 5–7 μ thick, or simply curved, 3-celled and 5–8 μ thick; sterigmata filiform, 15–20 x 2–4 μ, terminated by sporidia; sporidia reniform or ellipsoid, orange-colored, 10–16 x 5–9 μ.

On *Juniperus littoralis.*

Type locality: Tôtômi province (Shidzuoka-ken) Mikatagahara, Mar. 20, 1919 (K. Hara), Mar. 21, 1919 (K. Yoshida), Apr. 7, 1919 (Y. Watanabe).

Illustrations: 1 black-and-white plate giving 15 figures to show aecial form on Japanese pear leaf: section of a pycnium, its ostiolar filaments, pedicels of pycnospore, pycnospores, section of an aecium, peridial cells, formation of aeciospores, mature aeciospores, telia on leaves of *J. littoralis,* a swollen telium, colored teliospores, colorless teliospores, germination of teliospores and sporidia.

The appearance of the aecial stage is quite similar to that of *G. asiaticum,* except the aecia look more or less purplish in color.

Notes: Sand-pear culture in the Mikatagahara region was given up some time ago on account of the virulence of rust, though

no *Juniperus chinensis* was found in the vicinity. After careful examination, Hara found *J. littoralis* growing wild in the region, which carried telia looking quite different from those of *J. chinensis.* Inoculation, using type material collected by Watanabe, proved that this telial form infects *P. sinensis* very easily, but *P. aucuparia* (*Sorbus aucuparia, S. japonica*) remained free (l. c. 6^9: 751–752). Hara also suggested that the case reported by Ideta, regarding the leaf-inhabiting form of *Gymnosporangium* on *J. rigida* as the pear-rust organism, is one of misidentification of the host, because *J. littoralis* is often mistaken for *J. rigida* (l. c. p. 753).

SYNOPSIS OF JAPANESE GYMNOSPORANGIUM SPECIES *

I. TELIA ON STEM, CAUSING HYPERTROPHY

1. Telia on spheric swelling of the stem of *Juniperus chinensis,* and *J. chinensis* var. *procumbens;* aecia on *Pyrus Malus, P. spectabilis* and *P. Toringo;* aeciospores chestnut-brown.

GYMNOSPORANGIUM YAMADAE Miyabe, ex Yamada 1904, and Ideta 1911 (*G. Yamadai* Miyabe).

Syn. *G. claviaeforme* Dietel, *non* Jacq.
G. clavariiforme Syd., P. Henn., *non* Rees.
G. chinensis Itô, *non* Long.

2. Telia on fusoid swelling of the stem of *Juniperus chinensis,* and *J. chinensis* var. *procumbens*; aecia on *Photinia villosa* (*P. laevis*); aeciospores yellowish-brown.

GYMNOSPORANGIUM JAPONICUM Syd. 1899.

Syn. *Roestelia photiniae* P. Henn. in Hedwigia 33: 231, Aug., 1894. (Ex Itô, 1913.)
Roestelia pourthiaeae Miyabe in Shok. Zass. (Bot. Mag.) Tôkyô, 17^{192}: 35. M. 36, ii, Feb., 1903 (Japanese). (Ex Itô, 1917.)
Aecidium pourthiaeae Syd. in Bull. Herb. Bois. 1900, no. 4: 3. (Ex Itô, 1917.)
Gymnosporangium confusum Diet., *non* Plowr. in Engl. Bot. Jahrb. 28: 286. May, 1900 *pro parte.* (Ex Itô, 1917, p. 180.)
G. photiniae Kern. 1911.

* In looking over this synopsis, Prof. Miyabe kindly made the following comments:

(1) The plant here called *Juniperus chinensis* var. *procumbens* should be *J. chinensis* var. *Sargenti,* since *J. procumbens,* according to E. H. Wilson, represents an entirely different plant.

(2) The plant here called *Juniperus littoralis* is better called *J. conferta,* in accordance with modern classification.

(3) The apple rust fungus probably had been existing in the prefecture of Aomori for centuries, where the wild crab apple is found common.

3. Telia on fusoid swelling of the stem of *Juniperus rigida;* aecia on *Amelanchier asiatica*; aeciospores chestnut-brown.

GYMNOSPORANGIUM IDETAE Yamada ex K. Hara, 1916, 1921.

Syn. *Gymnosporangium tremelloides* Syd., *non* Hartig. (Ex Hara.)

G. juniperinum Shirai pro parte, *non* Fries. (Ex Hara.)

4. Telia on fusoid swelling of the stem of *Chamaecyparis pisifera, Ch. pisifera* var. *plumosa,* and *Ch. pisifera* var. *squarrosa;* aecia on *Pyrus Miyabei* and *P. Aria* var. *kamaoensis*; aeciospores yellowish-brown.

GYMNOSPORANGIUM MIYABEI Yamada & Miyake in Shok. Zass. (Bot. Mag.) Tôkyô, 22^{253}: 21–28. Feb., 1908.

Syn. *Roestelia solitaria* Miyabe in Shok. Zass. 17^{192}: 35 M. 36, ii, Feb., 1903. (Ex Yamada & Miyake.)

R. solenoides Diet. in Engl. Bot. Jahrb. **32**: 631. June, 1903. (Ex Yamada & Miyake.)

Gymnosporangium solenoides Kern in Bull. N. Y. Bot. Gard. **7**: 450. Oct., 1911.

II. TELIA ON LEAF OR ON GREEN STEM, NOT CAUSING HYPERTROPHY

5. Telia conic or spheric, on *Juniperus chinensis, J. chinensis* var. *procumbens,* and *J. rigida*; aecia on *Pyrus sinensis, Cydonia vulgaris, C. japonica,* and *Pyrus communis*; aeciospores yellowish-brown, 18–22 × 18–21 μ (P. Henn.).

GYMNOSPORANGIUM ASIATICUM Miyabe, ex Yamada, 1904.

Syn. *Roestelia koreaensis* P. Henn. in Monsunia 1: 5. 1900. (Ex Yamada.)

Gymnosporangium japonicum Shirai, *non* Syd. pro parte.

G. confusum Diet., *non* Plowr. pro parte. (Ex Itô, 1917.)

G. spiniferum Syd. (Ex Itô, 1917.)

G. haraeanum Syd. 1912.

G. chinensis Long. (Ex Kern, Jackson).

G. koreaense Jacks. 1916.

6. Telia oblate or hemispheric, on *Juniperus chinensis*; aecia on *Pyrus Zumi*; aeciospores yellowish-brown, 20–28 × 18–25 μ (K. Hara).

GYMNOSPORANGIUM HEMISPHAERICUM K. Hara. 1917.

7. Telia depressed-globose or oblate-ellipsoid, on *Juniperus littoralis*; aecia on *Pyrus sinensis;* aeciospores yellowish-brown, 18–23 × 16–18 μ (K. Hara).

GYMNOSPORANGIUM SHIRAIANUM K. Hara. 1919

UNDESCRIBED OR QUESTIONABLE SPECIES REPORTED FROM JAPAN

1. Telia on *Juniperus nipponica*; aecia on *Sorbus japonica* (*Pyrus aucuparia* var. *japonica*) and *S. sambucifolia* var. *pseudogracilis* (*P. aucuparia*).

GYMNOSPORANGIUM ALPINUM Yamada ex Hara in Byôchû-gai Zasshi (Journ. Pl. Prot.) 6^{9}: 754. T. 8, ix, Sept., 1919 (nomen nudum).

Syn. *Gymnosporangium juniperi* Itô, *non* Link, based upon Miyabe (1903) and Ideta (1911). In Byôchû-gai Zasshi 4^{4}: 246. T. 6, iv, Apr., 1917 (Japanese). (Ex Hara, l. c.)

G. juniperinum Miyabe, Shok. Zass. 17: (35), *non* Fries (Aecia only; on *Pyrus aucuparia.* 1903). Ideta; aecia on *Sorbus japonica,* telia on *Juniperus nana* (?) 1911. Also Yamada, 1904, p. 308; Shirai List ed. I, p. 39 pro parte.

2. Telia on unknown host, collected by Miyabe in Karafuto (Saghalien).

GYMNOSPORANGIUM CLAVARIAEFORME (Jacq.) Rees. Ex Ideta, 1911, p. 474–475.

(Collected by Miyabe in Karafuto on *Juniperus nana,* ex Hara, l. c.)

(Shirai, List ed. I, p. 39, *pro parte.* Aecia on *Sorbus* sp.: List ed. 2, p. 265, aecia on *Pyrus.*)

3. Telia on unknown host; aecia on *Photinia villosa.*

GYMNOSPORANGIUM BLASDALEANUM Kern, 1911 p. 438; 1916, p. 250.

Syn. *Aecidium pourthiaeae* Syd. (Ex Kern.)

4. Host entirely unknown.

ROESTELIA CANCELLATA Reb. ex Matsumura, Shokubutsu Meikwan, Index Pl. Japon. vol. 1: 171. M. 37, ii, Feb., 1904; Shirai List ed. 1, p. 88 (*Gymnosporangium Sabinae* for the synonym).

BUREAU OF PLANT INDUSTRY,
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NOTES ON SOME SPECIES OF COLEOSPORIUM—II

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(WITH PLATES 22 AND 23)

COLEOSPORIUM IPOMOEAE

Coleosporium ipomoeae (Schw.) Burrill was first described in the uredinial stage by Schweinitz[1] in 1822, as *Uredo ipomoeae;* Burrill[2] in 1885 described the telial stage and placed the fungus in the genus *Coleosporium.* The aecial stage was discovered by the senior writer near Luray, Va., on *Pinus echinata* in 1914, and it was described[3] and the proof of its connection with the uredinial and telial stages was published in a brief note in 1917.[4]

Inoculations with *Coleosporium ipomoeae* have been made during 1915 to 1919 as follows:

Sixteen sets of inoculations were made with aeciospores from aecia on *Pinus echinata* collected from the following localities: Mont Alto, Pa; Luray and Petersburg, Va.; Asheville, N. C.; Etowah, Tenn.; Clearwater and Columbia, S. C.; Atlanta, Columbus, and Macon, Ga.; Auburn and Selma, Ala.; and Texarkana, Ark. Plants as follows were inoculated: 1 *Amsonia ciliata,* 2 *Aster conspicuus,* 1 *A. longifolius,* 3 *Calonyction acu-*

1 Schweinitz, L. D. Synopsis fungorum Carolinae superioris. Schr. Nat. Ges. Leipzig 1: 70. 1822.

2 Burrill, T. J. Parasitic fungi of Illinois. Bulletin Illinois State Laboratory 2: 217, 218. 1885.

3 Hedgcock, Geo. G., & Hunt, N. Rex. New species of *Peridermium.* Mycologia 9: 239, 240. 1917.

4 Hedgcock, Geo. G., & Hunt, N. Rex. The Peridermium belonging to *Coleosporium ipomoeae.* Phytopathology 7: 67. 1917.

[MYCOLOGIA for SEPT. (14:235–295) was issued Sept. 1, 1922]

leatum, 6 *C. grandiflorum*, 1 *Chrysopsis mariana*, 2 *Convolvulus arvensis*, 13 *C. repens*, 11 *C. sepium*, 1 *Coreopsis verticillata*, 1 *Elephantopus carolinianus*, 2 *E. tomentosus*, 1 *E. nudatus*, 1 *Helianthus angustifolius*, 2 *H. decapetalus*, 3 *H. divaricatus*, 1 *H. radula*, 12 *Ipomoea batatas*, 2 *I. caroliniana*, 18 *I. lacunosa*, 16 *I. pandurata*, 5 *I. triloba*, 2 *Laciniaria elegans*, 3 *L. graminifolia*, 4 *Pharbitis barbigera*, 7 *P. hederacea*, 14 *P. purpurea*, 11 *Quamoclit coccinea*, 6 *Q. quamoclit*, 1 *Silphium simpsonii*, 1 *S. terebinthinaceum*, 1 *Solidago canadensis*, 1 *S. fistulosa*, 1 *S. rugosa*, 1 *S. multiradiata*, 1 *Vernonia glauca*, and 1 *Verbesina virginica*. Of these the following were infected, bearing mature uredinia in 14 to 18 days and mature telia in about 2 months: 14 *Ipomoea lacunosa*, 8 *I. pandurata*, 3 *Pharbitis barbigera*, and 4 *Quamoclit coccinea*.

Seven sets of inoculations were made from aeciospores from aecia on *Pinus palustris* collected in the following localities: Clearwater, S. C.; Brooksville, Gainesville, New Smyrna, and Ocala, Fla. Plants as follows were inoculated: 4 *Calonyction aculeatum*, 1 *Chrysopsis mariana*, 2 *Convolvulus arvensis*, 1 *C. sepium*, 3 *Ipomoea caroliniana*, 3 *I. lacunosa*, 5 *I. pandurata*, 10 *Laciniaria elegans*, 2 *L. elegantula*, 15 *L. gracilis*, 3 *L. pycnostachya*, 2 *L. tenuifolia*, 4 *L. graminifolia*, 6 *Pharbitis purpurea*, 4 *Quamoclit coccinea*, and 1 *Verbesina virginica*. The following plants were infected, bearing mature uredinia in 15 to 20 days and mature telia in about 2 months: 2 *Ipomoea lacunosa* and 5 *I. pandurata*.

Six sets of inoculations were made with aeciospores from aecia on *Pinus taeda* collected from the following localities: Atlanta and Macon, Ga.; Clearwater and Columbia, S. C.; and Petersburg, Va. Plants as follows were inoculated: 3 *Calonyction aculeatum*, 4 *C. grandiflorum*, 1 *Convolvulus arvensis*, 3 *C. repens*, 7 *C. sepium*, 1 *Coreopsis major*, 2 *Elephantopus tomentosus*, 1 *Helianthus angustifolius*, 2 *H. divaricatus*, 3 *Ipomoea batatas*, 6 *I. caroliniana*, 8 *I. lacunosa*, 3 *I. pandurata*, 5 *I. triloba*, 2 *Pharbitis barbigera*, 3 *P. hederacea*, 9 *P. purpurea*, 5 *Quamoclit coccinea*, 3 *Q. quamoclit*, 1 *Solidago fistulosa*, 1 *S. juncea*, 2 *Verbesina virginica*, and 1 *Vernonia glauca*. The following plants

were infected bearing mature uredinia in 14 to 18 days, and mature telia in about 2 months: 2 *Ipomoea caroliniana*, 1 *I. lacunosa*, 3 *I. pandurata*, 1 *I. triloba*, 1 *Pharbitis barbigera*, 2 *P. hederacea*, and 3 *Quamoclit coccinea*.

In the foregoing experiments all plants of species of *Calonyction* and *Convolvulus* failed of infection, although the majority were in prime growing condition. The plants of *Calonyction aculeatum* were grown from seed from a plant heavily infected with the rust in nature.

Coleosporium ipomoeae is known to occur in its aecial stage in nature on six species of pine. In this stage its range is from Pennsylvania to Florida and Texas. It is now reported for the first time on *Pinus caribaea* from Florida. In its uredinial and telial stages it occurs over a much wider territory, ranging from New Jersey and Kansas on the north to Florida and Texas on the south. In these stages it is found on species of *Calonyction, Convolvulus, Ipomoea, Pharbitis,* and *Thyella*. It has been successfully inoculated by the writers on *Ipomoea caroliniana, I. lacunosa, I. pandurata, Pharbitis barbigera, P. hederacea,* and *Quamoclit coccinea*.

The two most common and susceptible host species for the uredinial and telial stages of *Coleosporium ipomoeae* are *Ipomoea pandurata* and *Pharbitis barbigera,* of which the former has a much greater range. The most common and susceptible host species for the aecial stage is *Pinus echinata*.

COLEOSPORIUM RIBICOLA

Coleosporium ribicola (Cooke and Ellis) Arthur was first described in the uredinial stage by Cooke and Ellis[5] in 1878, as *Uredo ribicola*. The telial stage was described by Prof. Arthur[6] in 1907, and the fungus assigned to the genus *Coleosporium*. Dr. Long[7] discovered and described the aecial stage and proved its connection with the *Coleosporium* in 1916.

5 Cooke, M. C., & Ellis, J. B. New Jersey Fungi. Grevillea **6:** 86. 1878.

6 Arthur, J. C. North American Uredinales **7:** 86. 1907.

7 Long, W. H. The aecial stage of *Coleosporium ribicola*. Mycologia **8:** 309–311. 1916.

The following inoculations have been made with *Coleosporium ribicola:*

During 1917, three sets of inoculations were made with aeciospores from aecia collected on *Pinus edulis* at Poncha by E. Bethel and the writer, and at Stonewall, and Trinidad, Colo., by E. L. Johnston and the senior writer. The following plants were inoculated: 1 *Grossularia inermis* (Rydb.) Cov. & Britt., 5 *Ribes aureum* Pursh., 1 *R. malvaceum* Sm., 2 *R. nigrum* L., and 2 *R. odoratum* Wendl. Of these plants, 2 *R. aureum* were infected with the rust, bearing uredinia in 14 to 16 days.

June 22, 1918, aeciospores from aecia collected by E. Bethel and the junior writer, June 15, on *Pinus edulis* near Del Norte, Colo., were used to inoculate the following plants: 1 *Grossularia hirtella* (Michx.) Sprach., 1 *G. inermis,* 1 *G. innominata* Jancz., 1 *G. leptantha* (A. Gray) Cov. & Britt., 2 *G. missouriensis* Nutt., 1 *G. reclinata* (L.) Mill., 3 *Ribes alpinum* L., 2 *R. americanum* Mill., 2 *R. aureum,* 4 *R. inebrians* Lindl., 4 *R. nigrum,* 10 *R. odoratum,* and 4 *R. vulgare* Lam. Of these plants, the following became infected, bearing mature uredinia in 14 to 16 days and telia by August 1: 1 *Grossularia hirtella,* 1 *G. inermis,* 1 *G. innominata,* 1 *G. leptantha,* 1 *G. missouriensis,* 1 *G. reclinata,* 4 *Ribes inebrians,* 1 *R. nigrum,* 3 *R. odoratum,* and 3 *R. vulgare.*

The following additional species have been infected by inoculation with urediniospores: 1 *Grossularia divaricata* (Dougl.) Cov. & Britt., and 1 *Ribes fasciculatum* S. & Z.

October 13, 1916, sporidia from telia collected by the senior writer on *Ribes aureum* at Denver, Colo., were used to inoculate the needles of the following species of pine: 1 *Pinus caribaea,* 7 *P. edulis* Engelm., 1 *P. bungeana* Zucc., 1 *P. girardiana* Wall., 1 *P. mayriana* Sudw., 1 *P. monophylla* Torr. & Frem., 1 *P. pinea* L., 2 *P. rigida,* 1 *P. serotina,* 3 *P. strobiformis* Sudw., 3 *P. strobus,* 3 *P. taeda,* and 6 *P. virginiana.* Of these trees, 4 *P. edulis* and 1 *P. pinea* were infected, bearing numerous pycnia December 16, 1917, and very sparse aecia February 28, 1918.

Coleosporium ribicola in its aecial stage resembles very closely in gross morphology *Coleosporium ipomoeae,* and since the two

species may have a common host in the north central United States, a comparison of the two species is now given:

Coleosporium ipomoeae

Pycnia conspicuous in single extended rows on chlorotic spots in leaves, olivaceous-black to brownish-black when old, 0.4 mm. wide by 0.7 mm.[8] long (Pl. 22, fig. 1).

Aecia in single extended rows, flattened rhomboidal, rupturing apically, 0.7 mm. high by 1.6 mm. long (Pl. 22, fig. 1).

Aeciospores 19 by 26 μ with walls 1.5 μ thick.

Peridial cells 22 by 42 μ with walls 5 μ thick.

Coleosporium ribicola

Pycnia conspicuous in single short rows on chlorotic spots in leaves, hazel to chestnut-brown when old, 0.4 mm. wide by 0.7 mm.[9] long (Pl. 22, fig. 2).

Aecia in single short rows, flattened rhomboidal, rupturing apically, 1.3 mm. high by 2 mm. long (Pl. 22, fig. 2).

Aeciospores 18 by 30 μ with walls 3.5 μ thick.

Peridial cells 23 by 26 μ with walls 4 μ thick.

Coleosporium ribicola, according to our records, has been collected as follows in the United States:

O and I on Pinus:

P. edulis: Colorado and New Mexico.

II and III on Grossularia and Ribes:

Grossularia cynosbati (L.) Mill: Minnesota and Wisconsin.

G. inermis: Colorado, New Mexico, Utah, and Wyoming.

G. leptantha: Colorado and New Mexico.

G. reclinata: Colorado, Minnesota, and Wisconsin.

G. setosa (Lindl.) Cov. & Britt: Wyoming.

Ribes americanum: Colorado and Wisconsin.

R. aureum: Colorado, New Mexico, Minnesota, South Dakota, Utah, and Wyoming.

R. coloradense:[10] Colorado, New Mexico, and Utah.

R. inebrians (includes *R. pumilum* Nutt.): Arizona, Colorado, Montana, New Mexico, South Dakota, Utah, and Wyoming.

R. mescalerium Cov: New Mexico.

R. montigenum McCl: Colorado.

R. odoratum: Colorado, Minnesota, New Mexico, and Utah.

R. sanguineum: Minnesota.

R. wolfii: Colorado and New Mexico.

[8] For *C. ipomoeae* in each case 100 measurements are given from 10 collections, 4 on *Pinus echinata*, 2 on *P. rigida*, and 2 on *P. taeda.*

[9] For *C. ribicola* in each case 10 measurements from one collection on *Pinus edulis* are given.

[10] Credit should be given to Professors E. Bethel and A. O. Garrett for many collections of this rust from the Rocky Mountain region.

Coleosporium ribicola has been successfully inoculated on *Pinus edulis, P. pinea, Grossularia divaricata, G. hirtella, G. reclinata, G. inermis, G. innominata, G. missouriensis, Ribes americanum, R. aureum, R. fasciculatum, R. inebrians, R. nigrum, R. odoratum,* and *R. vulgare.*

The specimens of *Coleosporium ribicola* from Minnesota and Wisconsin were collected in 1917 to 1919. The rust, although sparse, was widely disseminated in Wisconsin in 1918. No aecial host for the rust in these two states has been found, nor is the reason known for its sudden appearance in 1917, and apparent disappearance since 1919.

COLEOSPORIUM SOLIDAGINIS

Coleosporium solidaginis (Schw.) Thüm. was first described in the uredinial stage by Schweinitz[11] in 1822. The telial stage was described by von Thümen[12] in 1878 and the fungus assigned to the genus *Coleosporium.* The aecial stage was described by Underwood and Earle[13] in 1896 and called *Peridermium acicolum.* Proof that this *Peridermium* is the aecial stage of *Coleosporium solidaginis* was published by Dr. Clinton[14] in 1907.

In 1906,[15] Arthur and Kern described *Peridermium montanum* as a new species on *Pinus contorta* from the northwestern United States and Canada. The senior writer in 1914[16] infected *Aster* with this species, and Weir and Hubert in 1915[17] infected species of *Aster* and *Solidago* with it, and this species was assigned to *Coleosporium solidaginis.*[16]

11 Schweinitz, L. D. Synopsis fungorum Carolinae superioris. Schr. Nat. Ges. Leipzig 1: 70. 1822.

12 von Thümen, F. New Species of American Uredineae. Bul. Torrey Club 6: 216. 1878.

13 Underwood, L. M., & Earle, F. S. Notes on the Pine Inhabiting Species of Peridermium. Bul. Torrey Club 23: 400. 1896.

14 Clinton, G. P. *Peridermium acicolum* the aecial stage of *Coleosporium solidaginis.* Science, N. S. 25: 289. 1907.

15 Arthur, J. C., & Kern, F. D. North American Species of Peridermium. Bul. Torrey Club 33: 413. 1906.

16 Hedgcock, G. G. Identity of *Peridermium montanum* with *Peridermium acicolum.* Phytopathology 7: 64, 67. 1916.

17 Weir, J. R., & Hubert, E. E. Inoculation Experiments with *Peridermium montanum.* Phytopathology 6: 68, 70. 1916.

Inoculations as follows have been made with the aeciospores of *Coleosporium solidaginis* from 1913 to 1921:

Fourteen sets of inoculations were made with aeciospores from aecia collected on the needles of *Pinus echinata* from Mont Alto, Pa.; Petersburg, Va.; Biltmore, Black Mountain, and Marion, N. C.; Etowah, Tenn.; Columbia, Greenville, and Florence, S. C.; Gainesville and Macon, Ga.; Opelika, Ala.; and Meridian, Miss. Plants as follows were inoculated: 2 *Aster cordifolius*, 2 *A. conspicuus*, 2 *A. geyeri*, 2 *A. laevis*, 8 *A. macrophyllus*, 6 *A. paniculatus*, 1 *A. undulatus*, 5 *Chrysopsis mariana*, 6 *Elephantopus tomentosus*, 1 *Helianthus occidentalis*, 2 *Ipomoea fistulosa*, 1 *I. pandurata*, 1 *Laciniaria acidota*, 3 *Parthenium integrifolium*, 4 *Pharbitis purpurea*, 5 *Solidago bicolor*, 1 *S. chapmanii*, 5 *S. fistulosa*, 1 *S. hispida*, 2 *S. juncea*, 16 *S. multiradiata*, 2 *S. riddellii*, 5 *S. rugosa*, 4 *S. serotina*, 1 *S. speciosa*, 1 *S. squarrosa*, 4 *Vernonia flaccidifolia*, 5 *V. glauca*, 2 *V. noveboracensis*, and 4 *Verbesina virginica*. Of these plants, only those of *Solidago* were infected as follows: 1 *Solidago bicolor*, 1 *S. fistulosa*, 2 *S. juncea*, 16 *S. multiradiata*, 3 *S. rugosa*, 3 *S. serotina*, 1 *S. speciosa*, and 1 *S. squarrosa*. Mature uredinia were formed in 14 to 20 days, and mature telia in 2 to 3 months.

Seventeen sets of inoculations were made with aeciospores collected on the needles of *Pinus rigida* from Pleasantville, N. J.; Cold Spring Harbor, N. Y.; Caledonia, Greenwood Furnace, and Mont Alto, Pa.; Sugar Grove, O.; Harpers Ferry, W. Va.; Bluemont and Roanoke, Va.; Takoma Park and Washington, D. C.; and Black Mountain, Hot Springs, and Fayetteville, N. C. Plants as follows were inoculated: 2 *Aster acuminatus*, 10 *A. conspicuus*, 10 *A. cordifolius*, 3 *A. divaricatus*, 2 *A. dumosus*, 5 *A. ericoides*, 9 *A. geyeri*, 1 *A. hesperius*, 1 *A. laevigatus*, 2 *A. lentus*, 2 *A. lowrieanus*, 4 *A. macrophyllus*, 4 *A. paniculatus*, 2 *A. patens*, 1 *A. puniceus*, 1 *A. salicifolius*, 1 *A. undulatus*, 1 *A. vimineus*, 1 *Coreopsis tinctoria*, 1 *C. verticillata*, 4 *Elephantopus carolinianus*, 8 *E. tomentosus*, 1 *Helianthus occidentalis*, 3 *Parthenium integrifolium*, 1 *Senecio aureus*, 1 *S. obovatus*, 6 *Solidago bicolor*, 1 *S. caesia*, 27 *S. canadensis*, 1 *S. chapmanii*, 1 *S. erecta*, 4 *S. fistulosa*, 18 *S. juncea*, 19 *S. multiradiata*, 1 *S.*

neglecta, 4 *S. nemoralis*, 6 *S. riddellii*, 1 *S. rigida*, 7 *S. rugosa*, 3 *S. sempervirens*, 4 *S. serotina*, 3 *S. speciosa*, 11 *S. squarrosa*, 1 *S. tortifolia*, 1 *Vernonia blodgettii*, 7 *V. flaccidifolia*, 2 *V. glauca*, and 6 *V. noveboracensis*. Of these plants, only those of *Solidago* were infected as follows: 2 *S. bicolor*, 18 *S. canadensis*, 1 *S. fistulosa*, 7 *S. juncea*, 17 *S. multiradiata*, 1 *S. neglecta*, 2 *S. riddellii*, 4 *S. rugosa*, 3 *S. serotina*, and 8 *S. squarrosa*. Mature uredinia were formed in 15 to 17 days, and mature telia in about 2 months.

Ten sets of inoculations were made with aeciospores from aecia collected on the needles of *Pinus taeda* from Petersburg, Va.; Fayetteville and Lumberton, N. C.; Andrews, Clearwater, Columbia, Henry, and Sumter, S. C.; Macon, Ga., and Selma, Ala. Plants as follows were inoculated: 2 *Aster conspicuus*, 1 *A. chapmanii*, 2 *A. cordifolius*, 1 *A. dumosus*, 2 *A. geyeri*, 1 *A. laevis*, 3 *A. macrophyllus*, 3 *A. paniculatus*, 1 *A. novi-belgii*, 2 *A. undulatus*, 1 *A. vimineus*, 2 *Chrysopsis mariana*, 2 *Coreopsis major*, 5 *Elephantopus carolinianus*, 7 *E. tomentosus*, 1 *Helianthus angustifolius*, 2 *H. annuus*, 3 *H. divaricatus*, 1 *H. tuberosus*, 3 *Parthenium integrifolium*, 5 *Pharbitis purpurea*, 1 *Solidago bicolor*, 3 *S. canadensis*, 2 *S. chapmanii*, 4 *S. fistulosa*, 8 *S. juncea*, 8 *S. multiradiata*, 2 *S. riddellii*, 3 *S. rugosa*, 3 *S. serotina*, 2 *S. speciosa*, 3 *Vernonia angustifolia*, 5 *V. glauca*, and 6 *Verbesina virginica*. Of these plants, only those of *Solidago* were infected as follows: 3 *S. canadensis*, 7 *S. juncea*, 7 *S. multiradiata*, 2 *S. rugosa*, 2 *S. serotina*, and 2 *S. speciosa*. Mature uredinia were formed in 15 to 17 days and mature telia in about 2 months.

Six sets of inoculations were made with aeciospores from aecia collected on the needles of *Pinus pungens* from Sandy Hook, Md.; Bellville, Greenwood Furnace, and Mont Alto, Pa. Plants as follows were inoculated: 3 *Aster cordifolius*, 1 *A. geyeri*, 2 *A. lentus*, 1 *A. paniculatus*, 2 *A. undulatus*, 1 *Coreopsis verticillata*, 1 *Chrysopsis mariana*, 1 *Elephantopus tomentosus*, 2 *Helianthus occidentalis*, 7 *Solidago bicolor*, 3 *S. caesia*, 2 *S. canadensis*, 6 *S. multiradiata*, 1 *S. nemoralis*, 1 *S. riddellii*, 1 *S. speciosa*, 1 *S. squarrosa*, 2 *Vernonia glauca*, 3 *V. flaccidifolia*, and 2 *V. noveboracensis*. Of these plants, only those of species of *Solidago*

were infected as follows: 3 *S. bicolor,* 2 *S. canadensis,* 3 *S. multiradiata,* 1 *S. riddellii,* and 1 *S. squarrosa.* Uredinia and telia were produced in the usual time.

Four sets of inoculations were made with aeciospores from aecia collected on the needles of *Pinus resinosa* from Itasca Park, Minn. (collected by Mr. R. G. Pierce); Sharon, Vt. (collected by Dr. P. Spaulding); and Caledonia, Pa. Plants as follows were inoculated: 1 *Aster conspicuus,* 1 *A. cordifolius,* 1 *A. macrophyllus,* 1 *A. undulatus,* 3 *Campanula rapunculoides,* 1 *Convolvulus sepium,* 1 *Coreopsis verticillata,* 1 *Helianthus decapetalus,* 1 *Senecio aureus,* 1 *S. obovatus,* 2 *Solidago canadensis,* 6 *S. multiradiata,* 3 *S. riddellii,* and 1 *S. squarrosa.* Of these plants, only those of species of *Solidago* as follows were infected: 2 *S. canadensis,* 5 *S. multiradiata,* 1 *S. riddelli,* and 1 *S. squarrosa.* Uredinia and telia were produced in the usual time.

Two sets of inoculations were made February 26 and March 15, 1921, with aeciospores from aecia on *Pinus radiata* infected artificially October 7, 1920, with sporidia from teliospores from *Solidago bicolor.* The following plants were inoculated: 3 *Aster laevis,* 6 *Chrysopsis mariana,* 2 *Solidago bicolor,* 1 *S. monticola,* and 6 *S. multiradiata.* Only the plants of *Solidago bicolor* and *S. multiradiata* were infected, bearing mature uredinia in about 20 days, and mature telia in about 3 months. These inoculations were made at lower temperatures than those with aeciospores from species of pine, which were made chiefly in May and June. This explains the longer time required for the production of mature uredinia and telia.

One set of inoculations was made July 7, 1914,[18] with aeciospores from aecia collected by H. E. West of the Forest Service, on *Pinus contorta,* near Bozeman, Mont., June 25. The following plants were inoculated: 2 *Aster conspicuus,* 1 *A. cordifolius,* 2 *A. geyeri,* 2 *Coreopsis verticillata,* 2 *Elephantopus tomentosus,* 2 *Helianthus divaricatus,* 2 *Solidago canadensis,* 2 *S. juncea,* 2 *S. multiradiata,* and 2 *Vernonia glauca.* Of these plants, only those of *Aster conspicuus* and *A. cordifolius* were infected.

During 1914 to 1920, fifteen sets of inoculations were made, using urediniospores grown in pedigreed cultures from aecio-

[18] Hedgcock, G. G. L. c.

spore inoculations and taken from infected plants of *Solidago bicolor, S. canadensis, S. chapmanii, S. juncea, S. multiradiata, S. rugosa, S. sempervirens,* and *S. speciosa.* The following plants were inoculated: 3 *Aster conspicuus,* 2 *A. cordifolius,* 3 *A. geyeri,* 2 *A. laevis,* 5 *A. macrophyllus,* 1 *A. paniculatus,* 2 *A. pringlei,* 1 *A. undulatus,* 1 *Callistephus chinensis,* 6 *Chrysopsis mariana,* 2 *Euthamia graminifolia,* 3 *Elephantopus tomentosus,* 5 *Solidago bicolor,* 4 *S. canadensis,* 1 *S. chapmanii,* 1 *S. erecta,* 1 *S. fistulosa,* 1 *S. hispida,* 10 *S. juncea,* 23 *S. multiradiata,* 1 *S. neglecta,* 8 *S. riddellii,* 8 *S. rugosa,* 4 *S. serotina,* 3 *S. speciosa,* 7 *S. squarrosa,* 1 *Vernonia glauca,* and 2 *V. noveboracensis.* Of these plants, the following were infected, all bearing uredinia and some telia: 4 *Solidago canadensis,* 1 *S. hispida,* 7 *S. juncea,* 18 *S. multiradiata,* 2 *S. riddellii,* 3 *S. serotina,* and 2 *S. speciosa.* No plants of species of *Aster* were infected.

During 1915 to 1918, three sets of inoculations were made with urediniospores collected on *Aster paniculatus* near Harpers Ferry, W. Va., and on *A. longifolius* near Takoma Park, D. C. The following plants were inoculated: 1 *Aster divaricatus,* 1 *A. geyeri,* 4 *A. laevis,* 1 *A. longifolius,* 4 *A. macrophyllus,* 1 *A. vimineus,* 2 *Solidago juncea,* 1 *S. rugosa,* and 1 *S. serotina.* Only species of *Aster* became infected as follows: 2 *A. laevis* and 2 *A. macrophyllus.*

Two sets of inoculations were made on pine trees with sporidia from the telia of *Coleosporium solidaginis.* The first was made September 13, 1916, from telia collected by the writer on *Solidago rugosa* (no infected plants of *Aster* present) near Takoma Park, D. C., September 10. The following trees were inoculated: 2 *Pinus caribaea,* 3 *P. contorta,* 1 *P. coulteri,* 2 *P. echinata,* 1 *P. edulis,* 2 *P. mayriana,* 1 *P. montana,* 1 *P. palustris,* 1 *P. pungens,* 2 *P. rigida,* 2 *P. scopulorum,* 2 *P. serotina,* and 2 *P. taeda.* Of these trees the following were infected, bearing pycnia on or about December 21, 1916, and aecia about March 23, 1917: 1 *P. echinata,* 2 *P. rigida,* 2 *P. scopulorum,* and 1 *P. taeda.* The second set of inoculations was made in part from telia collected by the writer on *Solidago canadensis* near Chain Bridge, Va., September 28, 1920, and in part from telia col-

lected on *Solidago bicolor,* near Takoma Park, D. C., October 7 (no infected Asters present in either locality). Each collection was used in inoculations the day after collection. The following pines were inoculated: 2 *Pinus caribaea,* 3 *P. contorta,* 4 *P. coulteri,* 1 *P. edulis,* 1 *P. palustris,* 4 *P. radiata,* and 7 *P. rigida.* Of these, the following were infected, bearing pycnia on or about December 24, 1920, and aecia about March 15, 1921: 2 *P. caribaea,* 2 *P. coulteri,* 2 *P. radiata,* and 2 *P. rigida.*

No cultures could be made with pedigreed urediniospores from plants of species of *Aster* as none were infected in our inoculations with aeciospores. Urediniospores from infections on species of *Aster* in nature are apt to be mixed with those from infected species of *Solidago* which are nearly always present. In fact, the writer has usually found species of *Solidago* commonly infected in nature, and those of *Aster* rarely. Most of the species of *Aster* used in the inoculations were used because they were found infected in nature, and because of their known susceptibility.

The results from the inoculations are somewhat surprising. 132 plants of species of *Aster* and 241 of species of *Solidago* were inoculated with aeciospores from six species of pine from the eastern United States, viz., *Pinus echinata, P. nigra, P. pungens, P. resinosa, P. rigida,* and *P. taeda.* Of these, 142 plants of *Solidago* (59 per cent.) were infected and none of *Aster.* From inoculations with pedigreed urediniospores grown in the greenhouse on plants of species of *Solidago,* 19 plants of *Solidago* (25 per cent.) out of 77 inoculated were infected, but none of 19 plants of *Aster* inoculated were infected. These results may be interpreted in more than one way. It might be assumed that all the plants of *Aster* used were either from resistant species, or were not in proper condition for infection, neither of which is borne out by the facts, since many susceptible species were selected both of *Aster* and *Solidago,* and more than half of the plants were in splendid growing condition when inoculated. A more plausible explanation is that in the eastern United States we either have two races of *Coleosporium solidaginis,* the one on species of *Solidago,* the other on species of

Aster, or we have a second species of *Coleosporium* attacking species of *Aster*. The problem requires a further investigation before a definite solution is obtained.

Again, it must be noted that in the one experiment with aeciospores from aecia on *Pinus contorta* collected in Montana, 5 plants of *Aster* were inoculated, of which 3 were infected, and 6 plants of *Solidago*, all from the most susceptible species, were inoculated without infection. This indicates that this collection of aecia belonged to an *Aster* rust. The writer has collected the aecia of this rust on *Pinus contorta* in two regions in the west, one near Bozeman, Montana, the other in Estes Park, Colorado. The aecia in both cases were beyond maturity and immediately adjacent to the infected pine trees were infected plants of species of *Aster* which bore the uredinia of the *Coleosporium*. No infected plants of *Solidago* were found in either locality. In our inoculation experiments just given, 6 trees of *Pinus contorta* failed of infection when inoculated with the sporidia from the telia of the eastern form of the rust, although trees of *Pinus rigida* and *P. scopulorum* were abundantly infected from the same exposure under the same conditions. These results indicate that the western *Aster* rust may be distinct from the western *Solidago* rust which is probably identical with the eastern *Solidago* rust.

The aecia of *Coleosporium solidaginis* like those of *Coleosporium carneum* vary greatly in size, depending on the size of the needles of the species of pine infected. Those of *C. solidaginis* on pines with small needles, such are *Pinus echinata* and *P. pungens* (Pl. 23, fig. 1), are smaller than those on *P. rigida, P. scopulorum,* and *P. taeda* (Pl. 23, fig. 2). The pycnia and aecia of *Coleosporium solidaginis* are aggregated or clustered. Those of *C. carneum* (Pl. 23, fig. 3) on a given host are larger than those of *C. solidaginis* (Pl. 23, fig. 2), and are borne in more or less extended rows. The pycnia of *C. solidaginis* in color are grenadine-red to mahogany-red, those of *C. carneum,* orange-rufous to auburn or chestnut.

Coleosporium solidaginis has been reported as occurring naturally in its aecial stage upon 14 species of pine, chiefly in the

eastern United States.[19] It has been reported in the western United States only on *Pinus contorta* from Montana and Colorado.

Coleosporium solidaginis, in its form on *Solidago,* has been found occurring naturally in its uredinial and telial forms upon about sixty species of *Solidago,* in all regions of the United States, except in some of the southwestern states. It is now reported for the first time on the following species: *Solidago amplexicaulis, S. austrina, S. bootii, S. brachyphylla, S. celtidifolia, S. chandonnetii* Steele, *S. chapmanii, S. concinna, S. curtissii, S. decumbens, S. drummondii, S. erecta, S. fistulosa, S. glomerata, S. hispida, S. lancifolia, S. odora, S. petiolaris, S. pinensis* (Porter) Small, *S. pinetorum, S. pulverentula, S. purshii, S. rigida, S. rigidiuscula, S. speciosa, S. stricta, S. tortifolia, S. unigulata,* and *S. vaseyii.* The form occurring on species of *Aster* is known to occur on at least sixty species. In the eastern United States, it is now reported for the first time on the following species: *Aster acuminatus, A. concinnus, A. corrigiatus, A. hirsuticaulis, A. junceus, A. lowrieanus, A. oblongifolius, A. patulus, A. pringlei, A. schistosus* Steele, *A. spectabilis, A. tenuicaulis.* In the western United States it is now reported for the first time on *Aster fremontii, A. frondosus,* and *A. viscosum.* The form on the *Aster* has a range similar to that on *Solidago.*

Coleosporium solidaginis of the *Solidago* form in the eastern United States has been successfully inoculated by the writers from its telial stage on *Pinus caribaea* (*P. heterophylla*), *P. coulteri, P. echinata, P. nigra austriaca, P. radiata, P. rigida, P. scopulorum,* and *P. taeda,* and in its aecial stage upon *Solidago bicolor, S. canadensis, S. chapmanii, S. fistulosa, S. hispida, S. juncea, S. monticola, S. multiradiata, S. neglecta, S. pulverula, S. riddellii, S. rugosa, S. rupestris, S. serotina, S. speciosa,* and *S. squarrosa.*

The results of our inoculations indicate that in the eastern United States *Coleosporium solidaginis* is a rust attacking species of *Solidago* but not those of *Aster.* The *Coleosporium* on spe-

[19] Rhoads, A. S., Hedgcock, G. G., Bethel, E., & Hartley, C. Host Relationships of the North American Rusts, other than Gymnosporangiums which attack Conifers. Phytopathology 8: 324. 1918.

cies of *Aster* is apparently distinct from *Coleosporium solidaginis*. *Peridermium montanum* Arthur & Kern apparently belongs to a rust on *Aster* and if so is distinct from *Peridermium acicolum* Underw. & Earle, the aecial form of *Coleosporium solidaginis*.

INVESTIGATIONS IN FOREST PATHOLOGY,
BUREAU OF PLANT INDUSTRY,
U. S. DEPARTMENT OF AGRICULTURE,
WASHINGTON, D. C.

EXPLANATION OF PLATES

PLATE 22

Fig. 1. The pycnia and aecia of *Coleosporium ribicola* on the needles of *Pinus edulis* (× 2).

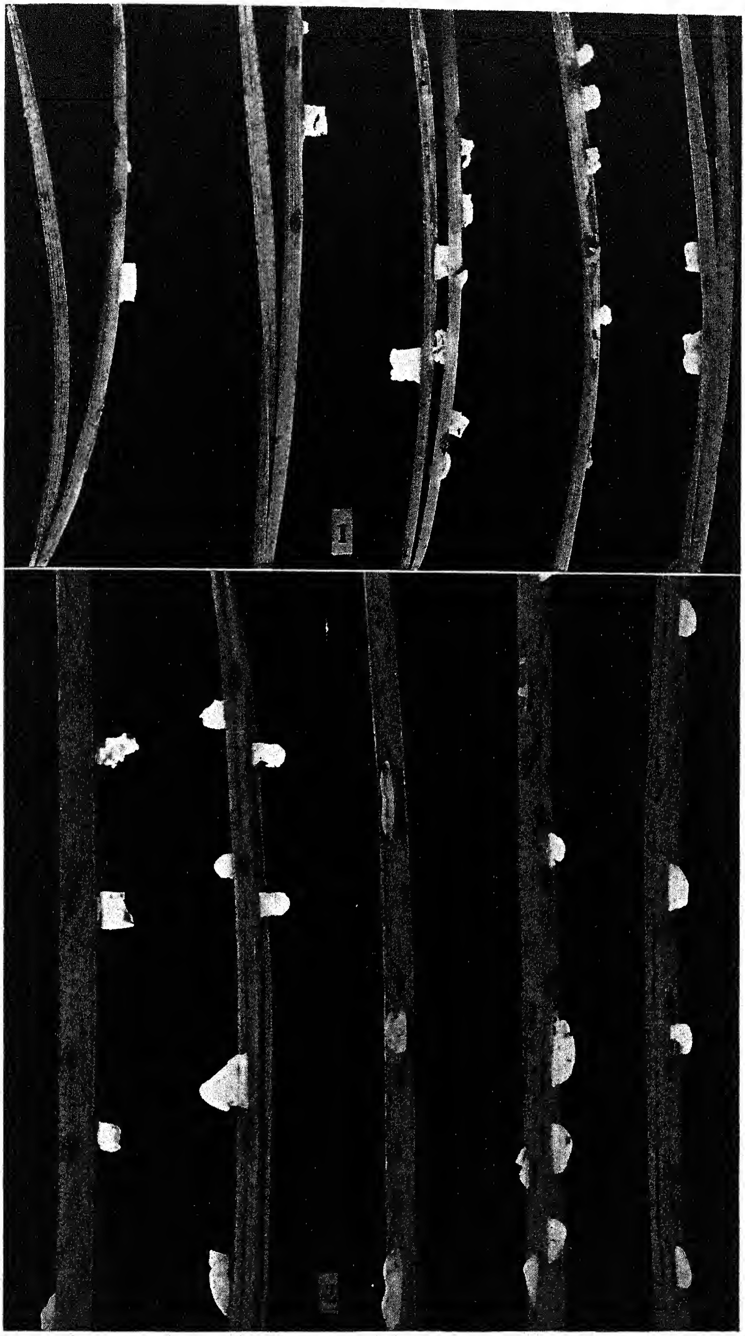
Fig. 2. The pycnia and aecia of *Coleosporium ipomoeae* on the needles of *Pinus palustris* (× 2).

PLATE 23

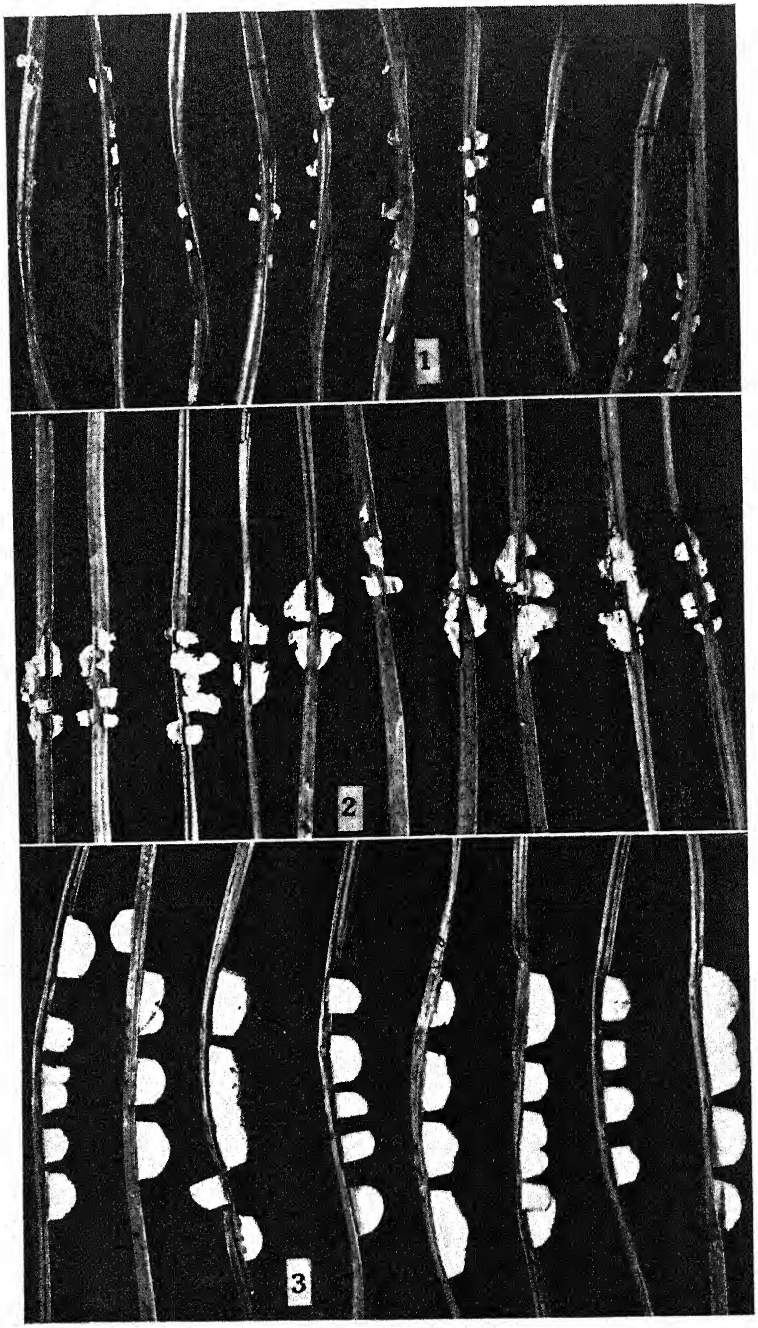
Fig. 1. Aecia of *Coleosporium solidaginis* on the needles of *Pinus pungens* (× 2).

Fig. 2. Aecia of *Coleosporium solidaginis* on the needles of *Pinus taeda* (× 2).

Fig. 3. Aecia of *Coleosporium carneum* on the needles of *Pinus taeda* (× 2).



SPECIES OF COLEOSPORIUM



Species of Coleosporium

A SKETCH OF THE HISTORY OF MYCOLOGICAL ILLUSTRATION (HIGHER FUNGI)[1]

Louis C. C. Krieger

(With Plates 24–31)

Every taxonomist will admit that illustrations are essential for the identification of many plants, and especially in the case of the fleshy, perishable fungi. To be really serviceable, however, a picture must be truthful. This seems self-evident, yet, if we make a survey of the available mycological illustrations from the earliest times to the present, we find that this quality of truthfulness was slow to develop. One of the causes of this is to be found in the freedom of the illustrator in following his imagination and another in the technical difficulties.

Like children, the old herbalists felt free to add fanciful embellishments to their pictures of plants. Porta's cuts are a good example. But the palm for nature-faking illustrating belongs to one Dr. Seger, who published (1671) under the name, *Anthropomorphus,* a cut of a "geaster," the open exoperidium of which discloses some miniature men and women, all apparently glad to glimpse the world after their imprisonment within the tissues of the plant (Pl. 24). In order to outdo the advocates of priority in nomenclature, our friend C. G. Lloyd of Cincinnati (1906*b*), has proposed (jocularly, of course, and under the *nom de plume,* "McGinty") to adopt Seger's name, *Anthropomorphus,* for the much later *Geaster* of Micheli (1729). (In parenthesis I may say that a super-conscientious systematist, in Europe, is said to have complained of his inability to find the name of this authority, "McGinty," in the literature of botany.) Another figure of Seger's, a *Xylaria*-like plant, would make a good illustration in a gynecological book.

[1] An illustrated paper read before the Botanical Society of Washington (D. C.), December 6, 1921.

Technical difficulties were no less obstructive. The only means at the disposal of the early herbalists was wood-engraving, and that art had only just reached the stage where a black line instead of a white one was produced in printing. Colored reproductions were entirely out of the question, as only some crude Italian prints from wood-blocks—initial letters, and the like—were known. There were no scientific artists in those days. The authors employed ordinary artists; and artists, as you may have learned from contact with them, are constitutionally opposed to being held down by plain, unadorned facts. Even Leonardo da Vinci, certainly a scientific man, as well as one of the greatest artists, could not resist giving an ornamental twist to his drawings of plants, drawings which, doubtless, were done for their botanic interest alone.

Let us outline chronologically the development of the principal technical means as employed by the mycologists in illustrating their works, from Clusius (1601) to Boudier (1905*b*).

The first period, that in which wood-engraving was the chief means of illustrating, embraces the fifteenth and sixteenth centuries. The wood-engraving practised by the artists of the herbalists was, as already indicated, a crude, black-line engraving. An outline-drawing was transferred to the smooth wood-block. With sharp instruments the surface was cut away everywhere except under the lines of the drawing. When completed, the block was held for printing as if it were type. In a more complex, shade-rendering form, in which white- and black-line engraving are intermingled, this ancient and most serviceable art persisted until displaced by the modern half-tone, some time in the early nineties of the last century.

The second period, in which steel- and copper-engraving played the principal rôle in mycological book-illustration, began late in the seventeenth century and lasted until well into the nineteenth.[2] In method of procedure it resembled the white-line engraving of the wood-engravers. The highly polished metal plate was cut into with suitable instruments to raise what is technically known

[2] As a means of artistic expression, it was used as early as the fifteenth century.

as a burr. This burr retained the ink for printing after the surface of the plate had been wiped clean. It is of interest that, as early as the year 1514, we find the great engraver, Albrecht Dürer, seeking a means of lightening the labors of engravers on metal. He had noticed that the armorers of his time produced the depressed, ornamental lines on cuirasses by employing acid mordants. It occurred to this wonderful man that the lines of a drawing might, similarly, be bitten into the metal, and a print made from ink left in the depressions. Dürer thus became the inventor of the art of pictorial etching, the process which, centuries later, made possible the half-tone and the tri-color print. His celebrated etching on iron, entitled "The Cannon," is here produced (Pl. 25).

Unless colored by hand—as was the practice from Paulet (1793*b*) to the time of the invention of lithography by the Bavarian actor, Alois Senefelder, between 1820 and 1830—engravings were issued without colors. But, contemporaneously with Paulet, Bulliard (1780) contrived a process by which the colors were printed on the engravings. Just how this was done, I cannot say. Very likely it was a revival of the early Italian wood-block color-printing.[3] Color-printing, as we commonly know it, before the advent of the tri-color process, was not introduced until Senefelder invented lithography.

The third period, the lithographic period, began at first with black-and-white printing, the color being added by hand as had previously been done with engravings. Fitch's figures, in Berkeley's "Outlines" (1860) and in Sarah Price's "Illustrations" (1864), are fine examples of hand-colored lithography; while the Scotchman, Greville, has left us a splendid set of hand-colored copper-engravings in his "Scottish Cryptogamic Flora" (1823).

It was not long before lithographers printed in colors. This accomplished, the way was clear for a satisfactory, as well as a more rapid, printing of fungus-pictures in their natural colors, the degree of excellence depending upon the artist who made the original paintings, and upon the lithographer who transferred the

[3] Weinmann had used a similar process in his "Phytanthoza iconographia" (1737*b*), the first work in which color was printed on engraved plates by "a new method." See Burch, Colour Printing (1910*b*), p. 66.

pictures to the stone. When tri-color printing came, these two possible sources of error were reduced to one, namely to the artist's original painting. Yet, it must be stated, though we gained in the objective rendering of a colored original through the use of the tri-color process, we also lost very materially, and this for two reasons.

First, tri-color printing, in order to counteract a certain dulling of colors[4] inherent in the process, sometimes employs highly fugitive coal-tar dyes. Secondly, in order to obtain the best results in printing, the surface of the paper must be extremely white and smooth, qualities that are secured by applying a coat of chalk. When one considers these two serious handicaps, it becomes a question whether this otherwise commendable process should be employed in reproductions that are to adorn works of high scientific value. We use and enjoy today the illustrated books of our predecessors who printed with comparatively safe colors on most enduring paper: our successors, centuries hence, will, I fear, have no such permanent, pictorial records of the work done by ourselves.

The other processes commonly used today in the reproduction of drawings and photographs, the zinc and copper line-engraving, the half-tone, and the heliogravure, need not detain us as all are familiar with the results. Of the two processes, however, the half-tone and the heliogravure, the former is much the less durable, for the reason that, as in the tri-color process, chalk-coated paper is usually the surface for the print. The mesh, present in all half-tone reproductions, may also be urged as an objectionable feature when a hand-lens examination for morphological details becomes desirable (Pl. 26). As examples of most satisfactory reproductions of photographs of fungi, the heliogravures issued a few years ago by the late Prof. E. T. Harper may be cited (1913, 1914*a, b,* 1916).

Let us now take a glance at the principal fungus-works of the past three hundred years. The very early herbalists paid little attention to the fungi, merely repeating what we find in the

[4] The blue and yellow colors, being complementaries, make a gray-green rather than a pure green.

ancient Greek and Roman writers, Theophrastus, Nikander, Pliny, Galen, and the rest. When there are figures, they are almost without exception extremely poor and almost useless. The earliest published illustrations of fungi that serve us today with any degree of satisfaction in the matter of generic and, in many cases, of specific determination are unquestionably those of Charles de l'Ecluse (Carolus Clusius) published by him in 1601 in his work on Hungarian fungi (1601). They are uncolored wood-cuts, rather clumsily done, but, for all that, sufficiently well characterized where common well-known species are shown. Much better and more serviceable in taxonomic work are the original water-color paintings from which the wood-cuts were made. These water-color pictures, done by an unknown artist working under the direction of Clusius' Hungarian friend and patron, Boldizsar de Batthyany, were published for the first time in colored, lithographic reproduction by Batthyany's countryman, Dr. Gyula de Istvanffi (1900*b*), just 320 years after they were painted, a circumstance which encourages me to believe that my own plates, now reposing in the Farlow collection, may yet see the light of day.

The Istvanffi volume embraces 89 plates—not 91, as the title-page declares. One of Dr. H. A. Kelly's[5] book-dealers in Europe wrote to Istvanffi to have him explain the discrepancy. Istvanffi replied that it was due to a typographical error which he could not correct.

The colored plates are so good that Istvanffi recognizes 112 of the 117 figures represented; and Reichardt (1876*c*) distinguished 47 genera and 102 species. Especially noteworthy are the figures of *Morchella esculenta* (Pl. 1), *Russula foetens* (Pl. 8), *Russula nigricans* (Pl. 13), *Russula virescens* (Pl. 40), *Amanita muscaria* (Pl. 28), *Amanitopsis plumbea* (Pl. 31), *Lepiota procera* (Pl. 58. Reproduced here, in black-and-white, in Pl. 27), and *Polyporus squamosus* (Pl. 19). One figure, that of *Russula foetens*, is so well done that the upper surface of the pileus distinctly shows where a slug ate through the substance

[5] *Editor's Note.*—Mr. Krieger is associated with Dr. Howard A. Kelly, of Baltimore, in mycological and scientific artistic work.

down to the level of the gill-attachments. Altogether, the figures are painted with a freshness of observation that indicates no mean ability on the part of the artist who painted them.

With the exception of Dr. Seger's aforementioned, copper-engraved figures of the anthropomorphic *Geaster* and the queer *Xylaria,* nothing of consequence appeared until Franciscus van Sterbeeck published his "Theatrum Fungorum" (1675).

For the most part this book is a mere curiosity. Its copper-engraved, uncolored figures are copies after Clusius, Seger, and others; indeed, both the *Anthropomorphus* and the *Xylaria* of Seger appear in re-engraved plates. A few are based on water-color drawings of his own finds. I wish to call attention to one of these, his figure of "*Locellus,*" on Pl. 15, at the letter "*C*" (Pl. 28, *A* in this paper). Much has been written on this figure by Kickx (1842*b*), and by Van Bambeke (1905*a,* 1908). The latter is inclined to regard it as a representation of the lower part of the stem of *Morchella crassipes.* A rather long, lacunosely-furrowed object of ovoid shape is shown. To me it suggests Peck's genus *Underwoodia,* a most remarkable discomycete of which E. T. Harper gave some good photographs in the *Bulletin of the Torrey Botanical Club* (1918*b*. See my Pl. 28, *B*).

In order to establish whether the two are identical or not, one would have to examine Sterbeeck's specimen for the presence of the hymenial layer, but, as the specimen has been long since lost, a further discussion is futile and unprofitable. Léveillé (1855), in his re-issue of Paulet, figures the plant in color, and calls it *Clathrus locellus,* a name that seems to have escaped the indexers. Antedating Van Bambeke, he, too, refers it to *Morchella,* but to *Morchella esculenta.* Other attempts to identify Sterbeeck's figures are those of Istvanffi (1894*b, c,* 1895*b, c*) and Britzelmayr (1894*a*). The poor quality of these engravings is to be wondered at as good workmen on copper were becoming plentiful about this time, the latter part of the seventeenth century. The reproduction of Rubens' pictures had called forth a swarm of them; Rembrandt, the master-etcher, must have exerted some influence on those about him; and Swammerdam was at work upon his marvellous drawings of the internal anatomy of the may-fly, published later by Boerhaave (1737*a*).

In the eighteenth century things began to brighten. The evil effects of the Thirty-Years War of the previous century were disappearing; the coffers of the kings and of the merchants were again filling with gold; the men of science thrived. Vaillant certainly looks prosperous enough in the portrait-engraving that forms the frontispiece of his "Botanicon Parisiense" (1727). But few fungi are figured in this work. *Peziza acetabulum* is well done, and so, perhaps, is *Cantharellus cibarius*. The figure of *Amanita phalloides*, on Pl. 14, recalls the fact that Vaillant is the author of the first fairly clear description of this deadliest of all agarics. The engravings, which were done by Claude Aubriet, are uncolored and very fine in execution; yes, too fine, for they show a finish that manicures and bedizens nature into a kind of studied artificiality which must have pleased the artificial people of his time.

Two years later (1729) appeared the work of the great Italian, Pier' Antonio Micheli, who was the first to point out definitely that fungi have reproductive bodies or spores. With the exception of Robert Hooke's drawing of the teleutospore of a *Phragmidium* (1665) and Marsigli's demonstration (1714) of the origin of fungi from mycelia, there is little in the literature before Micheli to indicate that fungi were anything more than freaks of nature produced by spontaneous generation or by thunderbolts, spooks, and the like. Micheli's epoch-making "Nova Plantarum Genera" (1729) changed the views of mycologists forever. Prof. A. H. R. Buller, of the University of Manitoba, pays a glowing tribute to this investigator in a paper entitled, "Micheli and the Discovery of Reproduction in Fungi" (1915). In some plates, carefully copied by Prof. Buller from the originals, are shown gills, tubes, cystidia, basidia, and spores, of agarics and boleti. The gill-fungi, described and illustrated by Micheli, have been critically reviewed by his countryman, Martelli (1884*b*), in the Nuovo Giornale Botanico Italiano.

Before proceeding, I would also call your attention to a curious drawing in Marsigli's work, the "Generatione Fungorum" (1714). One of the plates represents some agarics—apparently a species of *Coprinus*—growing from water in a flask, the neck

of which is corked up, in truly modern, pure-culture style, with a plug of some fibrous material (Pl. 29). It was not until 167 years later that a similar observation was made, by Dr. Farlow. In 1881, this eminent mycologist published an interesting account of the growth of a *Coprinus* on the surface of water contained in a glass jar that had stood for two months in his laboratory (1881*c*). To my knowledge, these two cases are the only ones on record where Basidiomycetes were found growing in or on water.

But, to continue. Micheli's "Nova Plantarum Genera" was followed by Battarra's "Fungorum Agri Ariminensis Historia" (1755), a work that fell short of the standard set by Micheli. To quote Persoon (1818), "In Battarra's time, the science of mycology had not yet acquired the impetus it exhibited later," that is, during his own time, at the end of the eighteenth and the early part of the nineteenth centuries. In Germany, during the years 1762 to 1774, Jacob Christian Schaeffer was issuing that milestone of illustrative mycology, his "Fungi of Bavaria and the Palatinate" (1762). The plates (hand-colored copper-engravings) are not particularly good, but important as one of the original sources for the figures of many well-known species. Persoon, in 1800 (l. c.), re-issued the work without change.

1761 saw the beginning of the extensive "Flora Danica" (1761) in which Vahl, Müller, and others described and figured new species. This work, and the "Flora of the Netherlands" (the "Flora Batava," 1800*a*), are performances, by small countries, which few larger ones have imitated.

In 1788 appeared James Bolton's "An History of Fungusses growing about Halifax" (1788), a work with wretched, hand-colored engravings, but with much historical significance, as is proven by the appearance, only last year, of Sartory and Maire's interesting and learned paper on the "Interpretation of Bolton's Plates" (1920*b*).

A veritable flood of illustrated mycological works was let loose from then on. In France, from 1786 to 1798, we have Pierre Bulliard's colossal "Herbier de la France" (1780), with 602 admirably executed, color-printed (!) engravings; and Paulet's

"Traité des Champignons" (1793*b*), with very inferior plates. Sowerby, in England, was publishing, from 1795 to 1815, the "Couloured Figures of English Fungi" (1795), which, with Greville's later "Scottish Cryptogamic Flora" (1823), represents the best that Britain has produced in the line of fungous illustrations—Cooke's "Illustrations" (1881*b*) notwithstanding.[6]

It must be noted here that Bulliard's set often lacks plates 601 and 602. These were re-issued by Raspail (1840); and Letellier (1829*b*) began a continuation of the "Herbier" by publishing, without text, a series of plates numbered from 603 to 710. Letellier's series is extremely rare, and the illustrations are inferior to those of Bulliard. Still worse is a series of 425 plates by Captain Lucand, 1881 to 1896, also intended as a continuation of Bulliard (1881*d*).

Paulet's "Traité" (1793*b*) is almost never to be had with its plates. Léveillé, in 1855, therefore, re-issued the 207 numbers, with no improvement in quality (1855).

With the dawn of the nineteenth century—in 1801—systematic mycology had its real beginning. All mycologists will recall that, in 1900, certain gentlemen of a conservative turn of mind assembled in the city of Brussels to fix a starting-point for the nomenclature of the fungi. After hearing the report of a committee (1910*a, c, d*), it was decided to take as a starting-point Elias Fries' Systema Mycologicum (1821). Two years before, at the 1908 meeting of the Botanical Society of America held in Baltimore, one voice, that of Prof. Elias J. Durand (1909*a, b*), was raised in favor of Christian Heinrich Persoon's "Synopsis Methodica Fungorum" (1801). Working in an attic in a poor quarter of Paris, this genius with infinite labor sifted the literature of the ages and, for the first time, brought order out of chaos. One hundred and nine years later, a Botanical Congress refused to recognize his great work. It is to be hoped that there will yet be a *real* International Botanical Congress which will deal with this subject with more reason and justice.

[6] Mr. Carlton Rea's "Monograph of the British Basidiomyceteae," the publication of which has just been announced, will undoubtedly add further luster to British illustrative mycology.

Persoon's "Synopsis" does not contain any colored illustrations, nor are there many plates in his two "Icones" (1798, 1803), but such as we find display fine taste and careful workmanship.

Of about the same quality are the illustrations which ornament the work of the Rev. Lewis David de Schweinitz, the first American mycologist. Born in Bethlehem, Pa., this minister in the Moravian church issued, in 1822, his "Synopsis" of North Carolina fungi (1822), with two hand-colored copper plates. Previously, while studying in Germany, he had published, together with his master, de Albertini, a work on the fungi of a district in Germany called "the Lausitz" (1805). Twelve colored plates, done by himself, accompany this publication. Before the time of de Schweinitz, little had been printed on the fungi of our country. The Rev. Mühlenberg's catalogues of Lancaster (Pa.) plants (1793*a*, 1799) contain mere lists, and Gronovius' "Flora Virginica," published in 1739 and 1743 (1739), notes a few collections by Dr. John Clayton, among them, *Lycoperdon solidum,* the "Tuckahoe" of the American Indians.

De Schweinitz's life and scientific labors have been recently treated with loving care and painstaking thoroughness by Drs. Shear & Stevens (1917). But, whereas de Schweinitz's auspicious beginnings in the mycology of this country bore no immediate fruits comparable with his own work, Europe, by contrast, was putting forth some important publications, many of them classics.

Italy gives us Giovanni Larber, whose work of 21 hand-colored plates (1829*a*) I have not seen; Domenico Viviani's "Fungi d'Italia" (1834), with 60 hand-colored lithographs of passable quality; and (1835) Carlo Vittadini's masterpiece, the "Descrizione dei Funghi Mangerecci." This work of 44 colored, engraved plates shows, by its incisive seriousness, kinship with the performance of Micheli, Vittadini's great predecessor.

Across the line, in Austria, things were stirring, too. About this time, Krombholz's 76 hand-colored "Naturgetreue Abbildungen der Schwämme" (1831) appeared in parts from 1831 to 1847. The figures in this rather comprehensive book are tolerably well drawn, but much too crowded on the page, and the colors

are merely dashed on. It is a bad practice to crowd figures on the page. Reference becomes difficult, and the individuality of the plants represented is lost in the general jumble.

The fourth decade of the new century offers, first, a work which I have not seen, Harzer's 80 plates, issued during the years 1842 to 1845 (1842*a*). Then, from England, in 1847, we get Badham's exceedingly well written, but poorly illustrated, "Treatise on the Esculent Funguses" (1847*a*), a later edition of which appeared in 1864, edited by Frederick Currey (l. c.). The first edition of the "Treatise" has 21 colored plates; the second, only 12. England, during this period, had also a woman mycologist, Mrs. T. J. Hussey, who presented to the world one of the most charming mushroom books known, her "Illustrations of British Mycology" (1847*b*), published in two series of hand-colored lithographs, 140 plates in all. The second series, comprising the last fifty plates, is very scarce.

As we approach the second half of the nineteenth century, the representation of the mere outward appearance of the fungi no longer satisfied—the internal, microscopic structures, the life histories, the phylogenetic, parasitic, and symbiotic relationships, were engaging the attention of mycologists. Such men as the Tulasne brothers, de Bary, Brefeld, de Seynes, and a host of others, arose. In great detail, and with surpassing skill, the Tulasnes studied and illustrated the external and the internal structures of the Hypogaei (1851), the lichens (1852), the Tremellineae (1853), and the gastromycetous groups and genera, Nidulariaceae (1844), *Lycoperdon, Bovista, Scleroderma, Polysaccum,* and *Geaster* (1842*c, d,* 1843*a, b*), and the Ascomycetes (1861*b*). I think it is safe to say that *never again will such hand-work appear as we find reproduced in the stupendous monographs issued by these two unassuming brothers. Commercialism has killed the possibility; men are no longer training their minds, eyes, and hands for such work—the art is dead!*

Along with these important investigational works, atlases of the greatest moment kept on appearing. For want of time, I can do little more than enumerate the best. First, and foremost, Elias Fries' "Icones" with 200 colored plates (1867), preceded

by his more popular "Sveriges Ätliga och Giftiga Svampar" with 93 colored plates (1861*a*); Gillet's "Champignons de France" (1874) with nearly 900 hand-colored lithographic drawings, which, because of the three systems of numbering, are difficult to consult (1876*a*, 1898); Kalchbrenner's 40 plates of Hungarian species (1873*b*, 1876*b*, 1884*a*); the Rev. Bresadola's "Fungi Tridentini" of 217 colored lithos. (1881*a*); the same author's "Funghi Mangerecci e Velenosi dell' Europa Media" (1899*a*); Cooke's "Mycographia" (1875), his 1199 "Illustrations of British Fungi" (1881*b*), and his "Australian Fungi" (1892), all of which have become more useful through commentaries (1899*c*, 1907); Quélet's "Champignons du Jura et des Vosges" (1872) with its many supplements and 66 (?) plates; Barla's "Champignons de Nice" (1859), followed by his "Flore Mycologique des Alpes Maritimes" (1888), together holding 112 colored plates; finally Lanzi's "Edible and Poisonous Fungi of Rome" (1894*d*), 131 hand-colored lithographs of only fair quality; and, Saunders and Smith's 48 colored plates (1871), part second of which was critically reviewed by the illustrious Fries (1873*a*).

Also there was an interminable number of lesser works: Berkeley's "Outlines" (1860), which has been called "a publisher's book"; Valenti-Serini's caricatures (he figures stems of Amanitas that look like designs for some new style of architectural column (1868*b*)); Leuba's figures on black backgrounds (1887); Richon and Roze's moderately good "Atlas" (1885); and Maximilian Britzelmayr's "Hymenomyceten aus Süd-Bayern" (1879, 1895*a*), a work that Lloyd has justly pronounced, "the poorest excuse for an illustrated work on fungi" (1914*c*). The drawings are mere bedaubed, mimeographed, or zinc-plate figures, on plates of unequal size, and in absolute disorder. Fortunately, Dr. von Höhnel has furnished the suffering systematist with an index to this chaotic mass (1906*a*).

Hollos' "Gastromyceten Ungarns" (1904) opens our century. If you wish to see what a sorry show the tri-color product—at its worst—presents when compared with really excellent lithographic reproductions, look at Hollos' book, and then turn to Boudier! The 600 magnificent, colored plates of Boudier's

"Icones" (1905*b*) run a close second to the Tulasne *chefs-d'oeuvre*. It is a positive delight to use them; indeed, were all published plates like these, there would be little question as to the identity of species. In nearly every case he gives the plant in different stages of development; the sectional views are always included, as are also the microscopic details (Pl. 30). Only 125 copies were printed, of which 115 were sold to the original subscribers. Eight copies were subscribed for in the United States. The subscription price for the entire work of three atlas volumes and one of text was $210.00. Today, the price is rapidly approaching $500.00.

Since the appearance of Boudier's masterpiece one other color-illustrated work of scientific importance has been published, namely, Rev. Adalbert Ricken's "Die Blätterpilze Deutschlands" (1910*e*). Boudier and Ricken are illustrations of the statement I made earlier, that the lithographic process, though producing the most durable results, has to contend with two variable factors, the artist and the lithographer. Given a good artist and a good lithographer, you get such work as Boudier's; with poor workmen, both on the paper and on the stone, you get Ricken's well-meant, but puerile, illustrations.

In conclusion, I would like to point out how little has been done in this country in the matter of publishing colored illustrations of our rich fungous flora.

First, we have de Schweinitz's early work (1822), already mentioned, with exactly two plates. Following him came the Rev. M. A. Curtis, who was urged by Asa Gray (1868*a*) to prepare a manual of the fungi of the United States. Nothing came of this. But, that Curtis seriously entertained the idea of publishing some comprehensive, illustrated manual of these plants, appears from statements made by E. R. Memminger (1905*c*) to the effect that Curtis actually left a fragmentary manuscript with illustrations. This is still in the possession of his children.

Indeed, the only atlas of colored illustrations of the commoner species of our fleshy fungi is the one published by the late Prof. Charles Horton Peck (1895*d*), who, for upwards of forty years, was the State Botanist of New York. Professor Peck's illustra-

tions, botanically accurate though they be, are not much more than colored diagrams, with little of the appearance of nature about them. Other illustrations by this most eminent student of our species are scattered through the reports of the New York State Museum. A few plates have also been published by Professor Murrill, of the New York Botanical Garden (1909*c*), and by Miss Burlingham (1921), all in the journal MYCOLOGIA.

McIlvaine's sketches in his "One Thousand American Fungi" (1900*c*) fall far short of even a half-respectable standard; and the few colored plates in Professor Atkinson's book (1900*a*) are so bad that they were omitted from the later editions.

Dr. Harkness' four colored plates in his paper on the Californian hypogaeous fungi (1899*b*) must not be omitted, as well as my own plates, published last year in the *National Geographic Magazine* (1920*a*, and Pl. 31 in this paper).

This short enumeration about completes the list of American colored figures of fungi to be found in our publications. Compared with the output of Europe,[7] it is negligible. But there is a ray of hope; Dr. Kelly has asked me to revise, and supply with colored illustrations, Prof. Peck's monograph of the genus Boletus (1889), the revision to stand as a memorial of this great American botanist. I trust that it may be printed.

BALTIMORE, MD.

EXPLANATION OF PLATES

Pl. 24. Dr. Seger's "Anthropomorphus," described in 1671.

Pl. 25. "The Cannon." Etching on iron by Albrecht Dürer.

Pl. 26. (*A*) Photographic enlargement (about 7 diameters) of the heliogravure reproduction shown in the upper left corner (*a*). A hand-lens examination of a heliographic reproduction of a photograph is thus instructive to the systematic mycologist, it being possible to determine whether the dimidiate gills are attached to their longer neighbors, or not. The opposite is true of the reproduction (*B*) of the half-tone figure (*b*).

Pl. 27. *Lepiota procera* (Scop.) Pers. Photographic reproduction from the colored lithographic figure in Istvanffi's Études et commentaires sur le code de l'Éscluse, pl. 58. The original of this figure was painted during the latter part of the sixteenth century, about 1580. See plate 31.

Pl. 28. (*A*) "Locellus," in Sterbeeck's "Theatrum Fungorum," pl. 15, at "*C*." (*B*) *Underwoodia columnaris* Peck. After E. T. Harper.

[7] See Laplanche (1894*e*) and Traverso (1910*f*) for two indexes of the available, published illustrations of fungi.

Pl. 29. Agarics (*Coprinus* species?) growing in a flask. After Marsigli's "Generatione fungorum."

Pl. 30. *Lepiota rhacodes* (Vittad.) Fr. Photographic reproduction of plate in Boudier's "Icones."

Pl. 31. *Lepiota procera* (Scop.) Pers. Photographic reproduction of a water-color painting by the author. The original in the possession of Dr. Howard A. Kelly. Reproduced in colors in the National Geographic Magazine, May, 1920. See plate 27.

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1887 **Leuba, F.** Les champignons comestibles et les espèces vénéneuses. Neuchâtel. f°. *54 pl.* (*mostly col.*).

—— —— 2 éd. Paris, 1906. *54 col. pl.*

—— —— Die essbaren Schwämme und die giftigen Arten, mit welchen dieselben verwechselt werden können. Basel, 1888–91. *Plates.*

1888 **Barla, J. B.** Flore mycologique illustrée. Les champignons des Alpes Maritimes. Nice, 1888–92. f°. *64 col. pl.*

1889 **Peck, C. H.** Boleti of the United States. Bull. New York State Mus. 2 (no. 8): 73–166.

1892 **Cooke, M. C.** Handbook of Australian fungi. London. *36 pl.* (*20 col.*).

1894 *a* **Britzelmayr, Max.** Die Hymenomyceten in Sterbeeck's Theatrum fungorum. Bot. Centralbl. **58**: 42–57. 1894; **61**: 209–211. 1895; **62**: 75. 1895.

b **Istvanffi, Gyula.** Franciscus van Sterbeeck's Theatrum fungorum. Természetrajzi Füzetek **17**: 137–161, 192–204. (Main text Hungarian; p. 192–204, German summary.)

c —— Sterbeeck's Theatrum fungorum im Lichte der neueren Untersuchungen. Bot. Centralbl. **59**: 385–404.

d **Lanzi, Matteo.** Funghi mangerecci e nocivi di Roma. Roma, 1894–1902. *131 col. pl.*

e **Laplanche, M. C. de.** Dictionnaire iconographique des champignons supérieurs. Paris.

1895 **Britzelmayr, Max.** Zur Hymenomycetenkunde. I–III Reihe. Berlin, 1895–97. *145 col. pl.* Text in Bot. Centralbl. v. 62, 68, 71.

b **Istvanffi, Gyula.** De rebus Sterbeeckii. Bot. Centralbl. **61**: 426–427.

c **Istvanffi, Gyula.** Das Theatrum fungorum von Clusius und Sterbeeck im Lichte der modernen Forschung. Bot. Centralbl. **64**: 153–154. (Abstract from Sitzungsb. Bot. Sect. Königl. Ungar. Naturw. Ges. Budapest, 9. Jan. 1895.)

d **Peck, C. H.** Edible and poisonous fungi of New York. Ann. Rept. New York State Mus. 48 (pt. 1): 203–334b. *Pl. 1–36.*

—— —— Ann. Rept. State Bot. New York 1894: 105–241. *Pl. A, 1–43* (*all but A, col.*). 1896.

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1898 **Peltereau, Ernest.** Notes bibliographiques sur l'oeuvre de M. Gillet "Champignons de France." Bull. Soc. Mycol. France **14**: 156–160.

1899 *a* **Bresadola, Giacomo.** I funghi mangerecci e velenosi dell'Europa media. Milano. *113 col. pl.*

—— —— 2d edizione. Trento, 1906. *112 pl.*

b **Harkness, H. W.** Californian hypogaeous fungi. Proc. Calif. Acad. Sci. III. Bot. **1**: 241–292. *Pl. 42–45.*

c **Plowright, C. B.** Notes and comments on the Agaricini of Great Britain. Trans. Brit. Mycol. Soc. (1897–1898) **1**: 37–46.

1900 *a* **Atkinson, G. F.** Studies of American fungi. Ithaca. *76 pl., 222 figs.*

b **Istvanffi, Gyula.** Études et commentaires sur le Code de l'Escluse. Budapest. f°. *89 col. pl.*

c **McIlvaine, Charles, & Macadam, R. K.** Toadstools, mushrooms, fungi, edible and poisonous. One thousand American fungi. Indianapolis. *Figs., plates* (*partly col.*).

1904 **Hollós, László.** Gasteromycetes Hungariae. Die Gasteromyceten Ungarns. Leipzig. f°. *31 pl.* (*part col.*).

1905 *a* **Bambeke, Charles van.** Sur un champignon non encore déterminé, figuré et décrit par Fr. van Sterbeeck. Bull. Soc. Mycol. France **21**: 205–208. *Fig.*

b **Boudier, Émile.** Icones mycologicae, ou Iconographie des champignons de France, principalement Discomycètes, avec texte descriptif. Paris, 1905–10. f°. *600 col. pl.*

c **Memminger, E. R.** Agaricus amydalinus M. A. C. Journ. Mycol. **11**: 12–17.

1906 *a* **Höhnel, F. X. von.** Index zu M. Britzelmayr's Hymenomyceten-Arbeiten. Ber. Naturw. Ver. Schwaben u. Neuburg **37**: 3–178.

b **Lloyd, C. G.** The species of the genus Anthropomorphus, Seger. By N. J. McGinty. In his Mycological Notes no. 21: 260. *Illus.*

—— —— In his Letter no. 48: 11–12. 1913. *Illus.*

1907 **Boudier, Émile.** Quelques rectifications et observations sur les Illustrations of British fungi de Cooke. Trans. Brit. Mycol. Soc. (1906) **2**: 150–157.

1908 **Bambeke, Charles van.** Le recueil de figures coloriées de champignons délaissé par Fr. van Sterbeeck. Bull. Soc. Roy. Bot. Belgique **44**: 297–338. *4 pl.*

1909 *a* **Durand, E. J.** The interpretation of pre-Persoonian names, and their bearing on the selection of a starting-point for mycological nomenclature. Science n. s., **29**: 271. Feb. 12. (Abstract of the following paper.)

b —— A discussion of some of the principles governing the interpretation of pre-Persoonian names, and their bearing on the selection of a starting-point for mycological nomenclature. Science n. s., **29**: 670–676. Apr. 23.

c **Murrill, W. A.** Illustrations of fungi, I–XXXII. Mycologia v. 1–12. 1909–20. *Col. plates.*

1910 *a* **Briquet, John.** Recueil des documents destinées à servir de base aux débats de la section de nomenclature systematique du Congrès internationale de botanique de Bruxelles 1910. Berlin.

b **Burch, R. M.** Colour printing and colour printers. London. *Plates (mostly col.).*

c **Farlow, W. G., & Atkinson, G. F.** The botanical congress at Brussels. Science n. s., **32**: 104–107. Jl. 22.

—— —— Bot. Gaz. **50**: 220–225. Sep. 21.

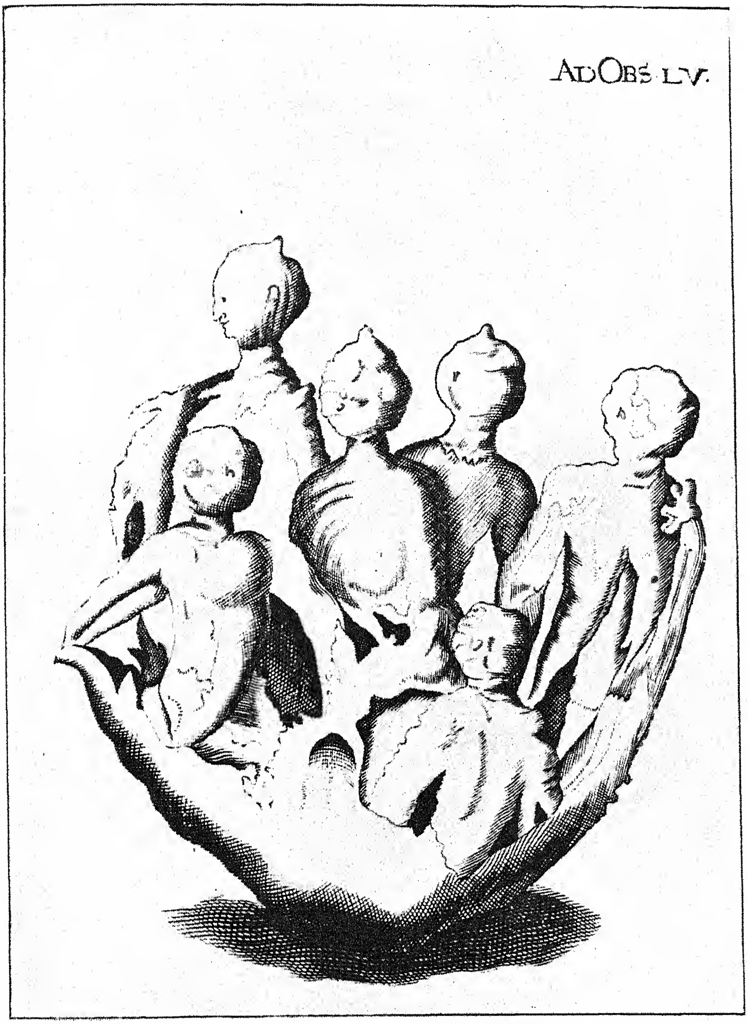
d **Lloyd, C. G.** Our latest laws "by authority." In his Mycological Notes no. 36: 478–479.

e **Ricken, Adalbert.** Die Blätterpilze (Agaricaceae) Deutschlands und der angrenzenden Länder. Leipzig, 1910–15. 2 v. *112 col. pl.*

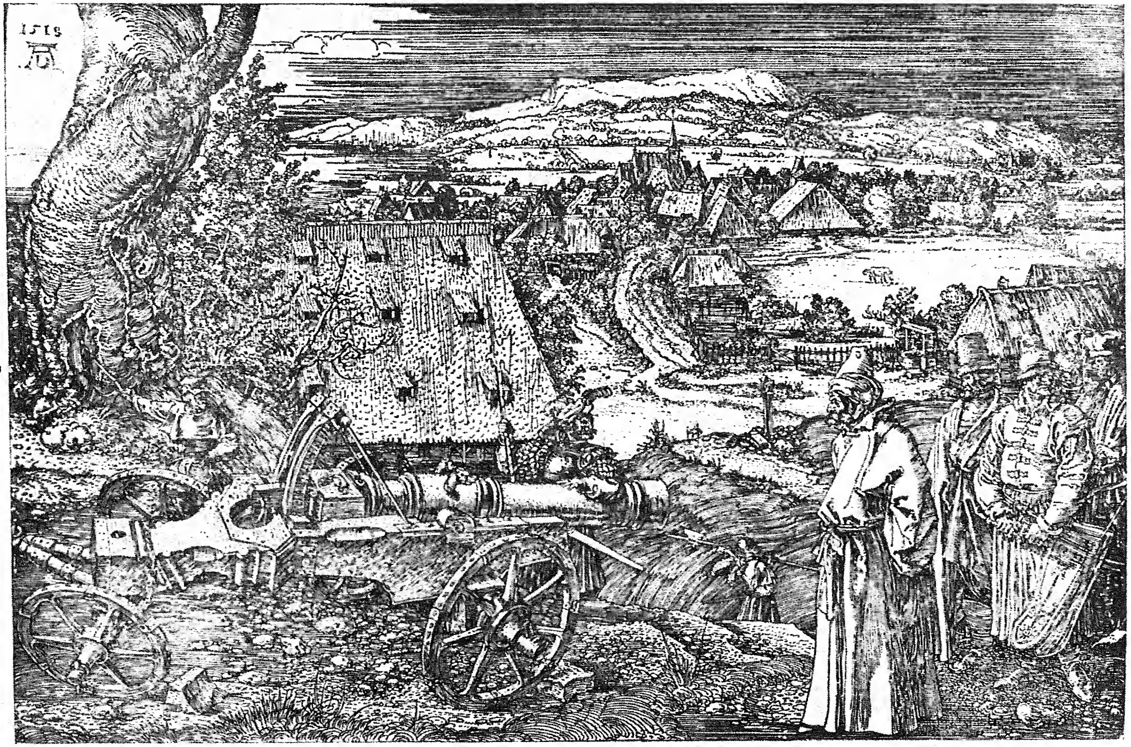
f **Traverso, G. B.** Index iconum fungorum. In Saccardo, P. A., Sylloge fungorum hucusque cognitorum v. 19–20. Patavii, 1910–11.

1913 **Harper, E. T.** Species of Pholiota of the region of the Great Lakes. Trans. Wisc. Acad. Sci. 17 (pt. 1): 470–502. *Pl. xxiv–lv.*

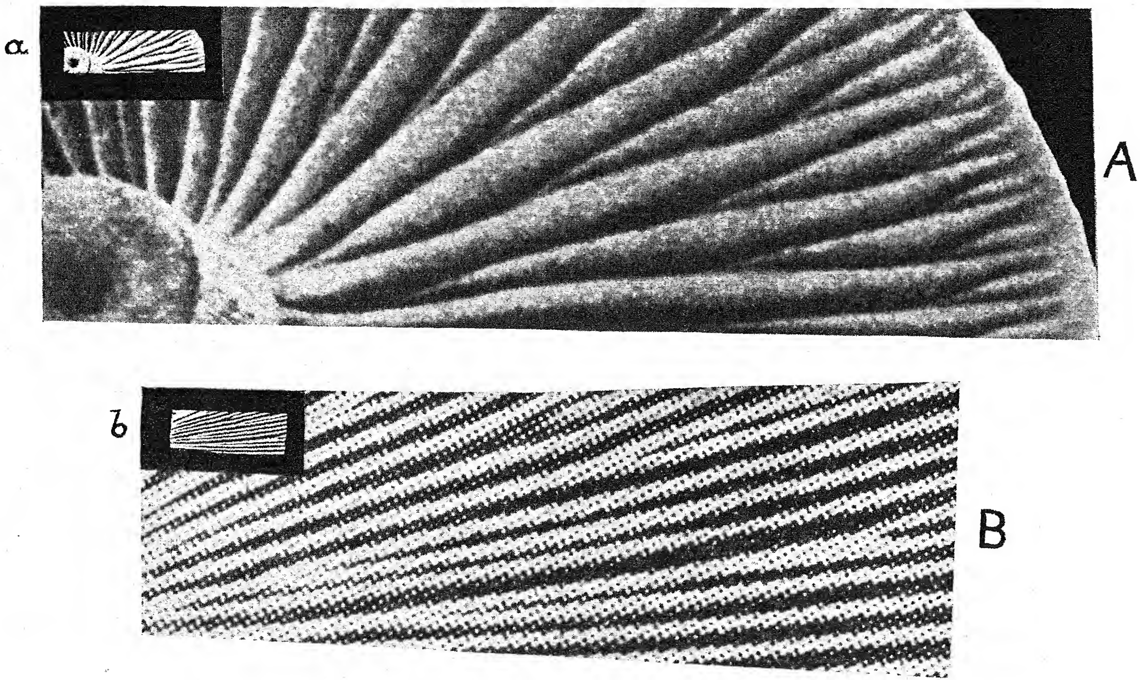
1914 *a* **Harper, E. T.** Species of Pholiota and Stropharia in the region of the Great Lakes. Trans. Wisc. Acad. Sci. 17 (pt. 2): 1011–1026. *Pl. lix–lxvii.*



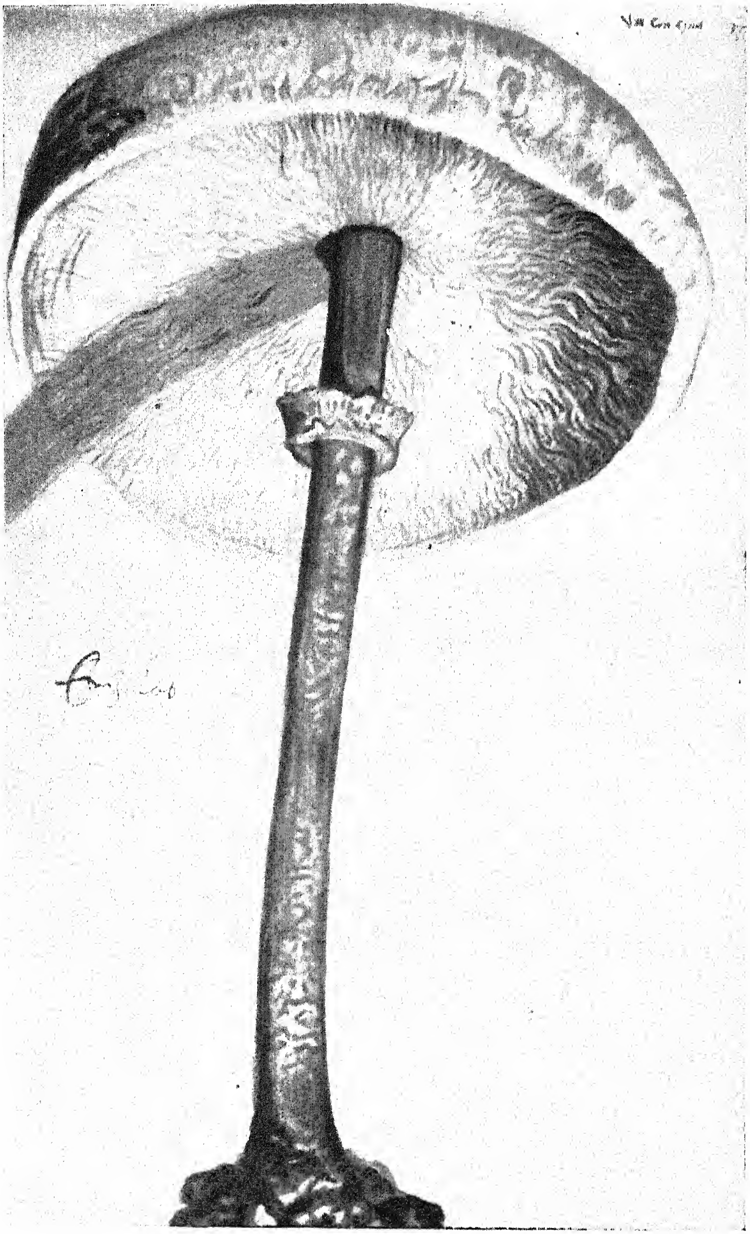
Dr. Seger's "Anthropomorphus"



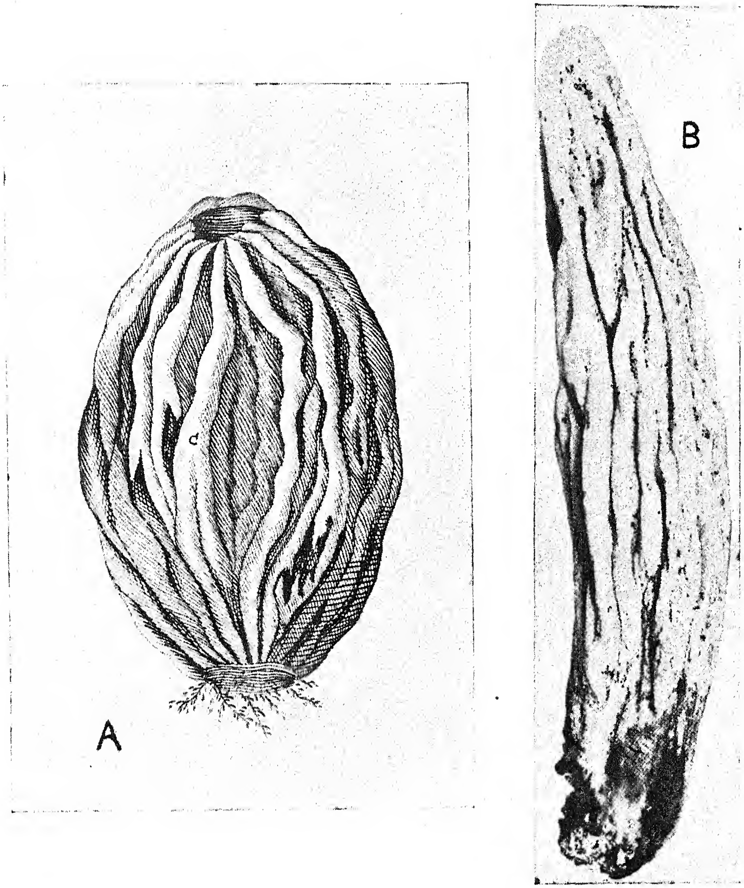
"THE CANNON," BY DÜRER



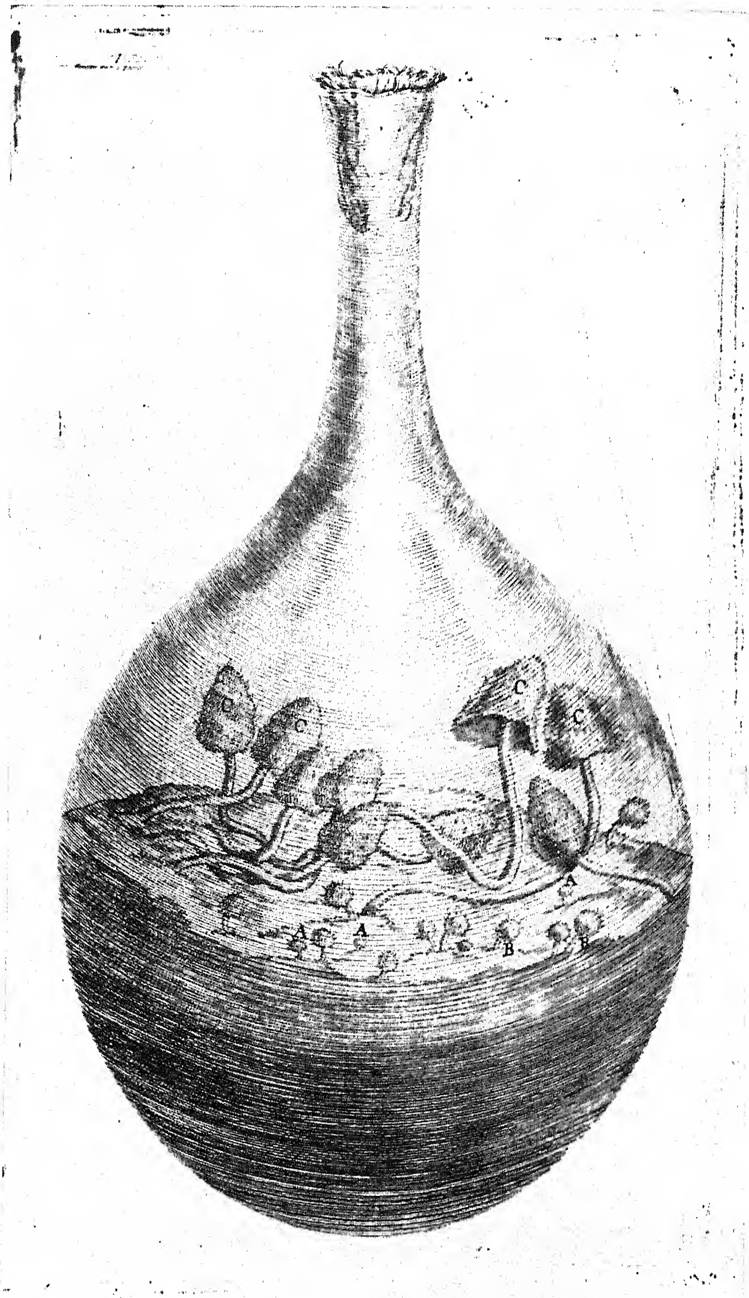
PHOTOGRAPHIC ENLARGEMENTS OF HELIOGRAVURE REPRODUCTIONS



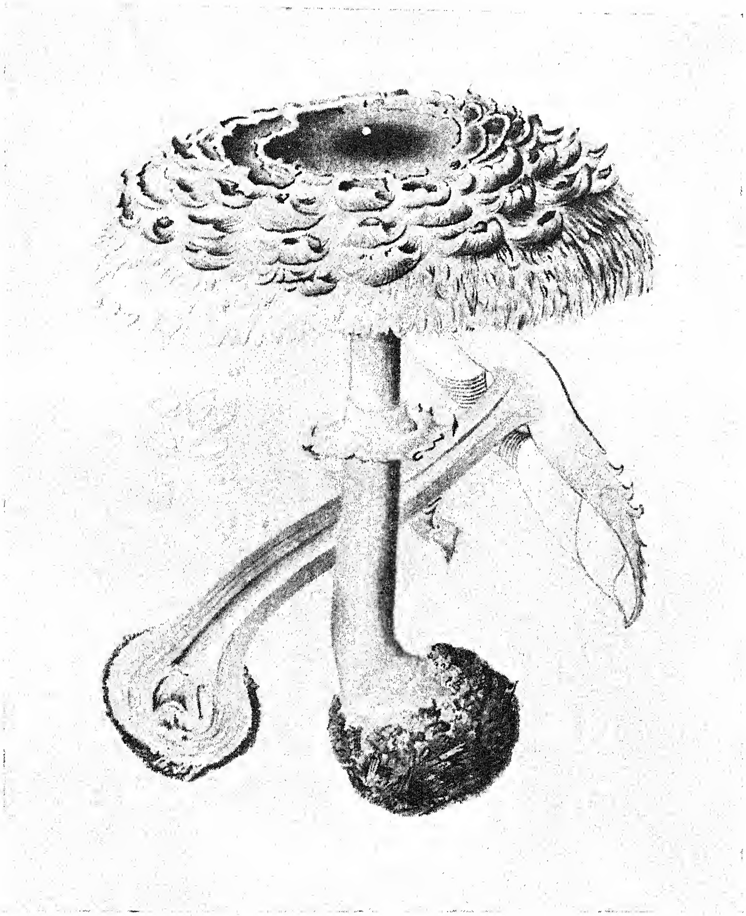
LEPIOTA PROCERA (SCOP.) PERS. FROM ISTVANFFI'S "ÉTUDES"



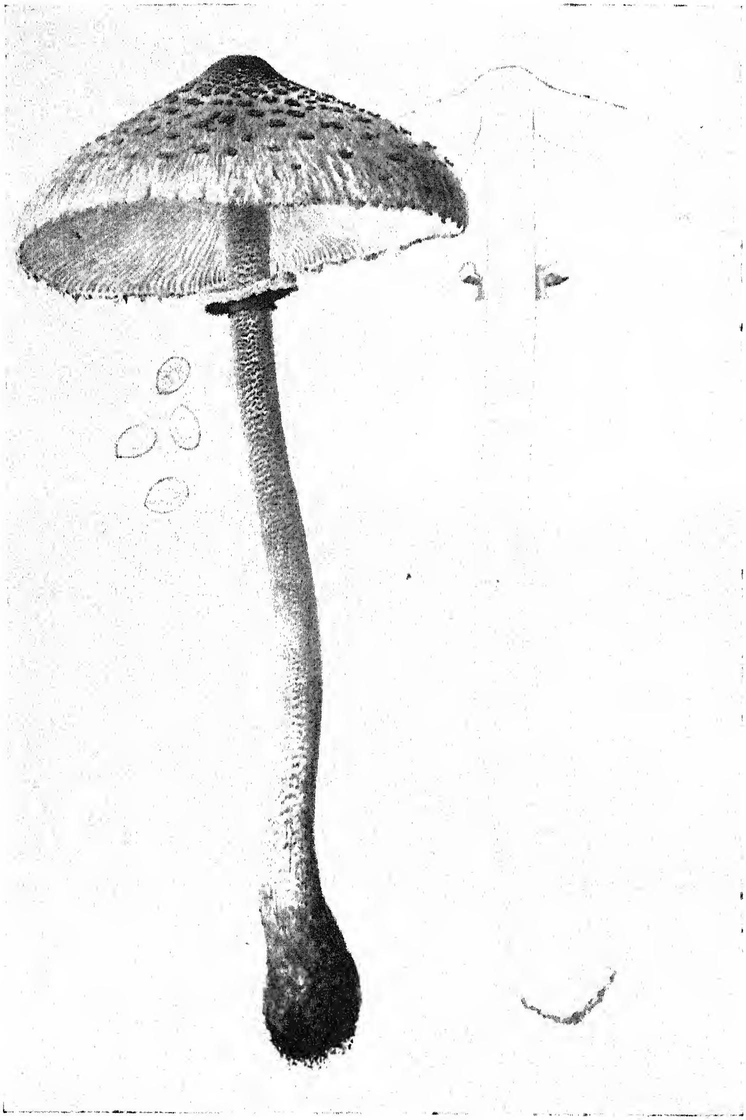
A. "Locellus," from Sterbeeck's "Theatrum"
B. Underwoodia columnaris Peck. After E. T. Harper



AGARICS (COPRINUS?). AFTER MARSIGLI



LEPIOTA RHACODES (VITTAD.) FR. FROM BOUDIER'S "ICONES"



Lepiota procera (Scop.) Pers. From Nat. Geogr. Mag.

b —— Species of Hypholoma in the region of the Great Lakes. Trans. Wisc. Acad. Sci. 17 (pt. 2): 1142–1164. *Pl. lxxii–lxxxiv.*

c **Lloyd, C. G.** [Britzelmayr, Hymenomyceten aus Südbayern.] Bibl. Contr. Lloyd Library 2: 248.

1915 **Buller, A. H. R.** Micheli and the discovery of reproduction in fungi. Trans. Roy. Soc. Canada III. 9 (pt. 4): 1–25. *Pl. 1–4.*

1916 **Harper, E. T.** Additional species of Pholiota, Stropharia, and Hypholoma in the region of the Great Lakes. Trans. Wisc. Acad. Sci. 18 (pt. 2): 392–421. *Pl. xi–xxiv.*

1917 **Shear, C. L., & Stevens, N. E.** Studies of the Schweinitz collections of fungi. I–II. Mycologia 9: 191–204, 333–344.

1918 *a* **Bensaude, Mathilde.** Recherches sur le cycle evolutif et la sexualité chez les Basidiomycètes. Nemours. *30 figs., 13 pl.*

b **Harper, E. T.** Two remarkable Discomycetes. Bull. Torrey Bot. Club 45: 77–86. *Pl. 1–3.*

1920 *a* **Krieger, L. C. C.** Common mushrooms of the United States. Nat. Geogr. Mag. 37: 387–439. *16 col. pl. and many photos.*

b **Sartory, Auguste, & Maire, Louis.** Interpretation des planches de J. Bolton on History of fungusses. Vol. I et II (1788). Saint-Nicolas-du-Port.

1921 **Burlingham, G. S.** Some new species of Russula. Mycologia 13: 129–134. *Pl. 7.*

INDEX TO ILLUSTRATIONS OF FUNGI, XXIII–XXXIII

William A. Murrill

In Mycologia for January, 1916, an index was published to species illustrated in the first 22 articles of my series on the higher fungi, which was begun in the first volume of Mycologia in 1909. Since that time, 11 more articles have appeared, which are indexed below. The total number of species described and illustrated to date is 249, the number represented in their natural colors being 213 on 29 plates.

Unfortunately, it has been necessary to crowd the figures on the plates, but most of them have been kept natural size and represent fairly well the species illustrated.

The idea of a great illustrated work on American fungi has been in my mind for many years and I have frequently spoken and written about it. Several hundred colored drawings have been prepared with such a work in view. When the raising of funds for this purpose became increasingly difficult, I decided to publish in a comparatively inexpensive way as many species as possible as quickly as possible; so that collectors might be stimulated to increase our knowledge of the fungous flora and thus prepare for a more comprehensive work when its publication should become possible. From the large number of letters and specimens received during recent years, I am convinced that it was wise to publish when I did. As one writer expressed it: "I'd much rather have a small colored figure now than a handsome folio plate after I am dead."

I still have faith, however, in the patriotism and generosity of American men of wealth, who will make it possible to supply nature-lovers in this country with ample, correct, and beautiful colored illustrations of our extremely varied and interesting fungous flora.

NEW YORK BOTANICAL GARDEN.

NOTES AND BRIEF ARTICLES

[Unsigned notes are by the editor]

The familiar stem-end rot of pineapples can be largely controlled, according to J. Matz, of the Porto Rico Department of Agriculture, by leaving longer stems on the fruit and fumigating with formaldehyde gas.

Sphaeropsis ulmicola is thought to be the cause of a serious canker of the branches of the American elm in Wisconsin. Most of the trees affected are fifteen years or more old. See Wisconsin Dept. Agric. Bull. 33: 158–163, by E. E. Hubert & C. J. Humphrey.

Mr. H. E. Parks has sent to the herbarium a number of interesting, original photographs of California fungi, including good views of *Rhizopogon maculatus, Hydnangium carneum,* and *Secotium tenuipes.*

Plant diseases, especially in greenhouses, have been traced in many instances to the water supply. W. F. Bewley and W. Buddin have cited a number of cases in a recent article in the *Annals of Applied Biology.*

A wither-tip of limes, caused by *Gloeosporium limetticola,* is said to be common on lime trees in British Guiana during July and August, when frequent applications of strong Bordeaux mixture are required to hold the disease in check. Fortunately, the fruits are usually immune after they are half grown.

Leaf-spot of orchids is not a single, specific disease, but a complication of various troubles needing careful and intensive investigation. This is the conclusion of a number of plant pathologists, including W. B. Brierley, of the new Rothamsted Experiment Station in England.

The needle-blight of white pine is said by J. H. Faull, who has observed and investigated it for several years, to be physiological in its nature. Warm, bright days in winter, when the ground is frozen and the roots inactive, cause excessive loss of water from the tips of the leaves and they dry out and become brown.

A paper by E. B. Mains on unusual rusts of *Nyssa* and *Urticastrum,* published in the *American Journal of Botany* for November, 1921, includes a description of the new genus *Aplospora,* based on *Uredo Nyssae,* and two new combinations, *Aplospora Nyssae* (Ellis & Tracy) Mains and *Cerotetium Dicentrae* (Trel.) Mains & Anderson.

Greenhouse diseases observed at Macdonald College, Quebec, were briefly noted by B. T. Dickson in a recent annual report of the Quebec Society for the Protection of Plants. The chief diseases discussed are: carnation rust; cineraria dwarfing, mosaic, and distortion; snapdragon rust; sweet pea powdery mildew; tomato mosaic and a leaf-mold; and violet leaf-spot.

A bud-rot of peonies, which has been observed by various persons during the past few years, was described by H. W. Thurston, Jr. & C. R. Orton in *Science* for 1921. Just as the flower buds are swelling, they turn black and decay, the disease often extending to the upper leaves and several inches of the stalk. Infected material yielded a species of *Phytophthora* closely related to *P. infestans.*

A bacterial disease of gladiolus, caused by *Bacterium marginatum,* was described by L. McCulloch in *Science* for 1921. It is abundant in and about Washington, D. C., and probably occurs also in Illinois and California. The affected leaves show elliptic spots that are at first rusty-red, then dull-brown or purplish. Moist, warm weather is very favorable to the growth of the pathogen, often resulting in the decay of the entire plant above ground.

The following new parasitic fungi were described and illustrated by J. J. Davis in the *Transactions of the Wisconsin Academy of Sciences* 20: 399–431. 1922: *Synchytrium pulvereum, Septoria coreopsidis, Gloeosporium balsameae, Ramularia minax, R. cilinodis, Sphaerulina pallens, Phacidium planum, P. expansum, P. balsameae, Lophodermium thuyae, Stagonospora tetramera, Piggotia vaccinii, Gloeosporium bicolor, Cladosporium astericola, Cercospora tuberculella,* and *C. tortipes.*

In an article by Miss Wakefield in the *West Indian Bulletin* for 1921, the general subject of mosaic diseases of plants and their origin is discussed at some length. Infection by a living organism seems to be the only way to cause mosaic, according to Miss Wakefield; while "discovery of a possible symplastic stage in bacteria, and of the formation of filterable gonidia which may produce new bacteria directly or after having entered the symplastic stage, appears to increase the possibility that eventually many of the infectious filterable viruses may prove to contain living organims."

The treatment of seeds before planting has usually been based on the supposition that the pathogen to be controlled was external; but C. C. Chen, of the Maryland Experiment Station, has discovered a number of internal fungous parasites of agricultural seeds. For example, *Cylindrophora* in asparagus seed; *Alternaria* in cabbage seed; *Fusarium, Macrosporium,* and *Alternaria* in common beans; *Fusarium* in lima beans; *Macrosporium* in cowpeas; *Macrosporium* and *Fusarium* in soy beans; *Oospora* in sweet corn seedlings; and *Rhizopus* in seeds taken from a rotten tomato. He recommends seed selection, the germination test, and the most approved hot water and hot air treatments.

Forty-two numbers of fungi were brought back from South America by Dr. H. H. Rusby, collected by himself and other members of the Mulford biological exploring party in Bolivia. Whenever possible, sufficient material was obtained to make four sets, three of them to be deposited at the New York Botanical Garden,

the Brooklyn Botanic Garden, and Harvard University, and the remaining one to be sent to Bolivia. These specimens are mostly woody polypores or tough gill-fungi. Attention may be called to the very rare *Camillea Leprieurii* Mont. and to the following species of less interest: *Armillaria alphitophylla* (Berk. & Curt.) Murrill, *Lentodiellum concavum* (Berk.) Murrill, *Lentinula detonsa* (Fries) Murrill, *Cookeina Tricholoma* (Mont.) O. Kuntze, and *Cladoderris dendritica* Pers.

INDEX TO VOLUME XIV*

New names and the final members of new combinations are in **bold face type**

* It has been considered unnecessary to include here the species listed in the three following articles, since they are already indexed or specially listed.

Arthur: Uredinales collected by Fred J. Seaver in Trinidad. See p. 23, 24.

Murrill: Index to illustrations of fungi, XXIII–XXXIII. See p. 332.

Wann and Muenscher: A preliminary list of the myxomycetes of the Cayuga Lake Basin. See p. 39.